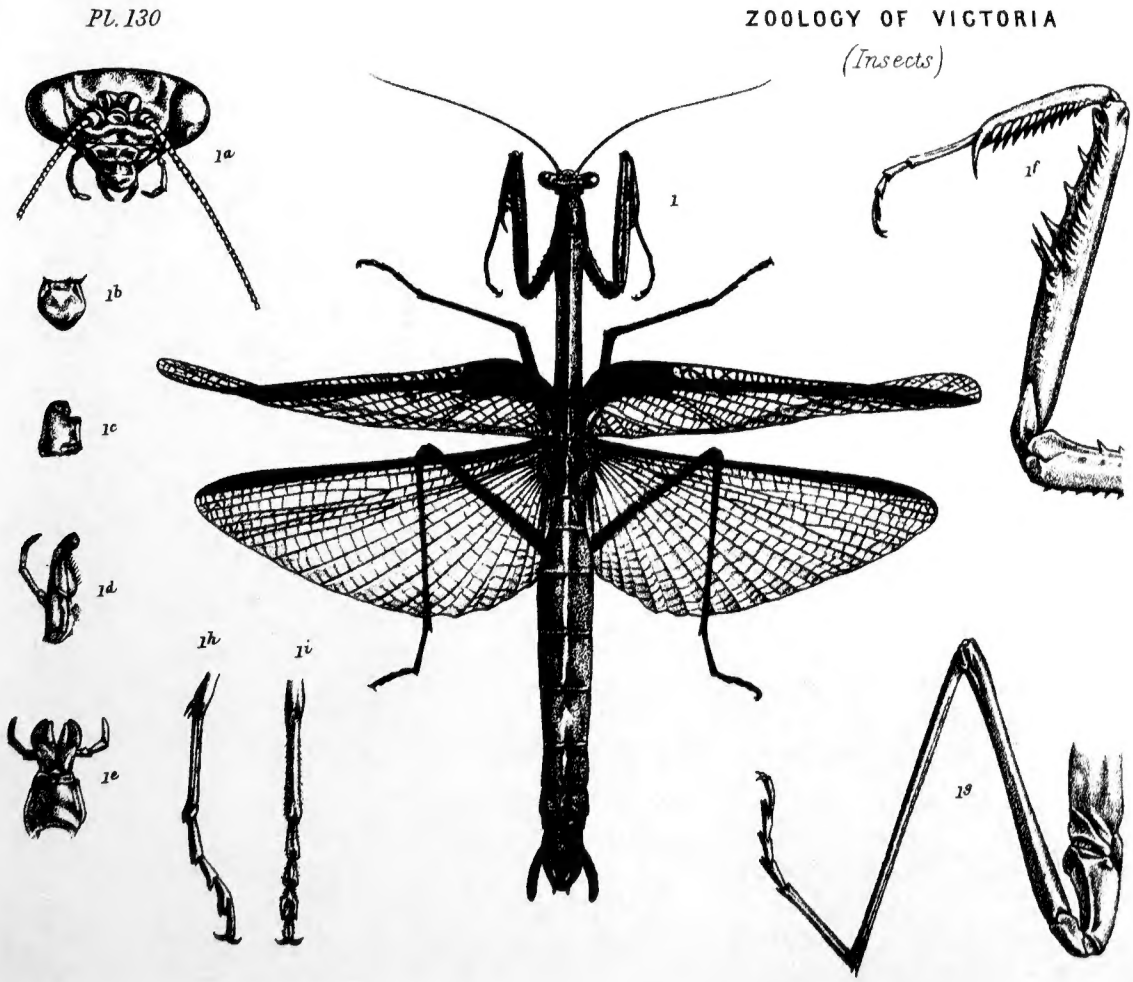
Memoirs of the

Volume 56
Number 1

Museum of Victoria

Melbourne Australia

28 February 1997



Cover: In Frederick McCoy's *Natural history of Victoria, Prodromus of the zoology of Victoria, or, figures and descriptions of all classes of the Victorian indigenous animals.* Vol. 2, Decade 13, published in 1886, he illustrated the mantis *Archimantis latistyla.* In this *Memoir*, Graham Milledge redescribes the species and others related to it.

ISSN 0814-1827

MEMOIRS

of the
MUSEUM OF VICTORIA

MELBOURNE AUSTRALIA

Memoir 56
Number 1
28 February 1997

PUBLISHED BY ORDER OF THE COUNCIL

Printed by Brown Prior Anderson Pty Ltd Burwood Victoria

Instructions to Authors

The Museum of Victoria was formed in 1983 by the merger of the National Museum of Victoria (established in 1854) and the Science Museum of Victoria (established in 1870). Among the Museum's objectives are scholarship and education in the fields of natural history, science and technology, and history of human society. The Museum of Victoria publishes two scientific serials to further these objectives, *Memoirs of the Museum of Victoria* (until 1983 *Memoirs of the National Museum of Victoria*) and *Occasional Papers from the Museum of Victoria.*

The *Memoirs* publishes papers on original research in the natural sciences pertinent to Victoria and/or the Museum's collections. All contributions are assessed by independant referees before publication.

The *Occasional Papers* are research documents of sufficient importance to be preserved but which are not appropriate for primary scientific publication. Papers are factual rather than interpretative studies, may be of special local interest, or may be longer than a normal scientific paper. Contributions will be refereed if appropriate.

Three copies of the manuscript with accompanying plates and figures should be submitted to the Scientific Editor, Museum of Victoria, GPO Box 666, Melbourne, Victoria 3000. Authors should consult a recent volume of the Memoirs to aquaint themselves with format.

Manuscripts must be typed on A4 paper, double-spaced, on one side of the paper and with ample margins. Presentation of the final manuscript on word-processor disks is essential. Papers should be arranged as follows: title (including higher classification of zoological taxa); authors' names and addresses; abstract; contents (only if the paper is very long); introduction and main text; acknowledgements; references; index (only if very long); and tables. Captions to text-figures and plates must be attached to the manuscript as final pages. Italics in the text should be restricted to generic and specific names. Measurements must be in the metric system (SI units).

References should be listed alphabetically at the end of the manuscript in the journal style. Journal titles must be in full. References to books must give the year of publication, edition, name of publisher and city of publication. See recent issues for details of format.

In taxonomic papers synonymies should be of the short form: taxon, author, year, pages, figures. A period and dash must separate taxon and author except in the case of reference to the original description. Photographs must have clear definition and be submitted as either glossy or flat prints at the actual size for reproduction. Line drawings for text-figures should be in black ink on white card or drawing film. Maximum full-page size is 140 mm wide by 193 mm; single column width is 67 mm. Clear lettering must be inserted. Original drawings up to twice final size are acceptable.

CONTENTS

Memoirs of the Museum of Victoria 56(1):1–63 (1997)

REVISION OF THE TRIBE ARCHIMANTINI (MANTODEA: MANTIDAE: MANTINAE)

G. A. MILLEDGE

Museum of Victoria, 71 Victoria Crescent, Abbotsford, Vic. 3067, Australia

Abstract

Milledge, G.A., 1997. Revision of the tribe Archimantini (Mantodea: Mantidae: Mantinae). *Memoirs of the Museum of Victoria* 56:1–63.

The Australo-Papuan tribe Archimantini is redefined. The genera *Pseudomantis* Saussure and *Rhodomantis* Giglio-Tos are excluded. The genus *Austromantis* Sjöstedt is recognised as valid and included. One new genus, *Corthylomantis*, and four new species, *Archimantis gracilis*, *A.vittata*, *Austovates papua* and *Corthylomantis baldersoni*, are described. *Archimantis minor* Giglio-Tos is a new synonym of *A.sobrina* Saussure, *Austromantis gracilis* Sjöstedt a new synonym of *A.albomarginata* Sjöstedt and *Coenomantis melanoptera* (Tindale) a new synonym of *C.kraussiana* (Saussure). *Archimantis inermis* Werner is transferred to the neotropical genus *Angela* Serville. The subspecies *Archimantis latistyla gigantea* Beier is rejected as invalid. Keys to genera and species are provided. Information on biology is recorded, distributions given and relationships discussed.

Introduction

The Archimantini includes medium to large, elongate mantids restricted to Australia (14 species) and Papua New Guinea (1 species). All inhabit shrubs and/or tall grasses where they are well camouflaged. They do not appear to be abundant in nature but many species can be encountered without much difficulty by searching in appropriate habitats. Species diversity is greatest in the tropical north of Australia, however several species occur in Victoria where the southern limit of the group is reached. There are no records of the Archimantini from Tasmania.

Giglio-Tos (1917) proposed the Archimantinae to include several Australian genera of the Mantidae, characterised by the first and fourth discoidal spines being not shorter than the second, wings reduced in the female and the facial shield wider than high. He divided the Archimantinae into two groups: the Archimantes, having the cerci compressed and the first discoidal spine longer than the second, containing the genera *Archimantis*, *Coenomantis* and *Rheomantis* (=*Archimantis*); and the Pseudomantes, having the cerci cylindrical and the first discoidal spine of equal length to the secnd, containing *Pseudomantis* and *Rhodomantis*. Beier (1935) rejected this, including the Archimantinae within the Mantinae. However Beier (1964) later created the tribe Archimantini which was essentially equivalent to Giglio-Tos' Archimantinae and included the genera *Archimantis*, *Austrovates*, *Coenomantis*, *Nullabora*, *Pseudomantis* and *Rhodomantis*. In this work the Archimantini is considered as equivalent to Giglio-Tos' Archimantes, characterised by the first discoidal spine being longer than the second (fig. 6) and including the genera *Archimantis*, *Austromantis*, *Austrovates*, *Coenomantis*, *Corthylomantis*, and *Nullabora*. The genus *Austromantis* was synonymised with *Pseudomantis* by Beier(1935) but is here considered a valid genus. *Pseudomantis* and *Rhodomantis*, which have the secnd discoidal spine as long or longer than the first, are removed to Beier's Mantini.

The tribe Archimantini thus contains six genera, one of which is new, and 15 species of which four are new. The largest genus is *Archimantis*, containing nine species of which two are new. Of the nine species and one subspecies listed for this genus by Balderson (1984) seven species are recognised as valid. *A.minor* Giglio-Tos is synonymised with *A.sobrina* and *A.latistyla gigantea* Beier is considered a variant and accorded no taxonomic status. The holotype male of *A.inermis* Werner has been examined and determined to belong to the neotropical genus *Angela* Serville. It was probably ascribed to Australia in error. Five of the remaining six genera are considered monotypic, while the sixth, *Austrovates*, contains two species of which one is new.

Methods and terminology follow those of Milledge (1990) except that the following abbreviations are used in the descriptions of male genitalia: aa — anterior apodeme of right

phallomere; apr — apical process of left phallomere, dl — dorsal lamina of left phallomere; dpr — distal process of ventral phallomere, lph — left phallomere; ml — membraneous lobe of left phallomere; pa — phalloid apophysis; rph — right phallomere; vl — ventral lamina of left phallomere; vpl — ventral plate; vspr — ventral sclerotized process (figs 7 — 8). Abbreviations used for institutions where material is held are as follows: AM — Australian Museum, Sydney; ANIC — Australian National Insect Collection, Canberra; BMNH — Natural History Museum, London; NMV — Museum of Victoria, Melbourne; NHRM — Naturhistoriska Riksmuseet, Stockholm; QM — Queensland Museum, Brisbane; RNHL — Rijksmuseum van Natuurlijke Historie, Leiden; SAM — South Australian Museum, Adelaide; UQ — University of Queensland, Brisbane; WAM — Western Australian Museum, Perth; ZMH — Zoologisches Museum, Hamburg; ZSIC — Zoological Survey of India, Calcutta.

Relationships

Two major groups can be recognized within the Australian Mantodean fauna. The first, smaller and probably more recent element contains genera which reach their greatest diversity outside the Australian region, in most cases the East Asian region. The Australian representatives of the genus *Acromantis* (1 sp.) (Hymenopodidae) and the genera *Hierodula* (4–5 spp.), *Mantis* (1 sp.), *Tenodera* (2 spp.) and *Statilia* (1 sp.) (Mantidae-Mantinae) fall into this category. It is notable that all have macropterous females and thus are probably capable of dispersal across water barriers.

The second, larger and probably older element consists of genera which are endemic to Australia or to Australia and nearby islands (including Papua New Guinea). Many of the species in this group have brachypterous females. The relationships of this older element are not entirely clear. For example the nearest relatives of the Australasian endemic subfamily Paraoxypilinae are the Amorphoscelinae (both Amorphoscelidae) which appear to be essentially African. An Australasian endemic subfamily of the Mantidae, the Orthoderinae, is most closely related to the Choreododinae, which occurs in southern India and Sri Lanka, and in South and Central America. This would imply a Gondwanan origin for the older element.

However, further work is required on the faunas of other regions before the relationships of the Australian representatives of the large subfamily Mantinae, including the Archimantini, can be clarified. Within the Australian fauna a possible candidate for sister group status of the Archimantini is the genus *Pseudomantis*, in which the 2nd discoidal spine is of similar length to the 1st, possibly representing a stage in the progressive reduction of this spine.

Relationships within the Archimantini are also obscure but perhaps less so. *Austromantis* appears closest in form to a presumed anscestor of the tribe, displaying several pleisiomorphic characters including only moderate elongation of the body, macropterous females and cylindrical cerci. *Nullabora* appears closely related to *Austromantis*, sharing the aforesaid characters as well as a bifurcate dpr in the male genitalia, which is not found in other members of the Archimantini. *Corthylomantis* also possesses cylindrical cerci, however, the colour pattern of the wing in the female may be a synapomorphy linking this genus with *Coenomantis*. *Austrovates variegata* displays a finely striped eye pattern and median projections between the abdominal tergites of juveniles, characters shared by *Coenomantis*. Juvenile *Archimantis quinquelobata* have abdominal projections and also display subapical lobes on the mid and hind femora similar to though less well developed, than those found in *Austrovates*, possibly indicating some relationship. The shallow U-shaped arrangement of the egg cells in the ootheca of *Archimantis quinquelobata* is shared with *Coenomantis*, however the form of oothecae within the Archimantini is not well enough known to interpret the significance of this.

Within the genus *Archimantis* several species groupings are apparent. Probable synapomorphies linking *A.latistyla*, *A.armata*, *A.monstrosa* and *A.sobrina* are robust build, ventral colour pattern of costal area of tegmen and broad based uncinate dpr of the male genitalia. Within this group the latter three species are also linked by the compact, strongly shagreened pa of the male genitalia. *A.brunneriana* and *A.straminea* share probable synapomorphies of very compressed head, angular eyes and mottled colour pattern on ventral surface of forecoxa. Males of *A.gracilis* and *A.vittata* are quite similar in appearance but the form of their genitalia is dissimilar. As the female of the latter species is unknown, the relationship between them remains uncertain. Further work may lead to the splitting of this genus, however, to do so now would be premature.

Archimantini

Diagnosis. Head anterio-posteriorly compressed, frontal shield transverse, first discoidal spine longer than second, margin of fore femur between outer spines smooth.

Notes. Members of the Archimantini can be collected by searching in shrubs and tall grasses, preferably at night with a spotlight. They tend to prefer denser growth, probably because it provides more cover from predators. Males are readily attracted to light traps at night. Specimens can be successfuly reared to maturity in flywire cages on a diet of live insects. The height of the cages should be at least three times the length of the mantis to provide adequate room for moulting and temperatures should be kept warm (25–30C). Individuals should be housed seperately to avoid canabalism and not in visual contact with one another to avoid stress.

Dry pinning is the preferred method of preservation for late instar nymphs and adults. Early instar nymphs are better preserved in alcohol. Specimens to be pinned should be gutted and stuffed as per the method of Rentz (1985: 9) to preserve body colour.

Key to genera of Archimantini (adults)

1.	Distal segments of cercus laterally compressed	4
—	Distal segments of cercus cylindrical	2
2(1).	Costal area of tegmen with white marginal band, females macropterous	3
—	Costal area of tegmen without white marginal band, females brachypterous	*Corthylomantis*
3(2).	Eye tapering to blunt point, cerci stout	*Nullabora*
—	Eye not tapering to blunt point, cerci slender	*Austromantis*
4(1).	Hindwings smokey black	*Coenomantis*
—	Hindwings mostly hyaline	5
5(4).	Mid and hind femora with distinct subapical lobe on posterior margin	*Austrovates*
—	Mid and hind femora without distinct subapical lobe on posterior margin	*Archimantis*

Austromantis Sjöstedt

Austromantis Sjöstedt, 1918: 28. Type species *Austromantis albomarginata* Sjöstedt, here designated.

Diagnosis. Head moderately anterio-posteriorly compressed, eye margin rounded angular; macropterous in both sexes; cerci cylindrical; dpr of male genitalia bifurcate.

Description. Body of moderate size and build. Head about 1.5 times as wide as high, moderately compressed anterio-posteriorly, slightly concave anteriorly (more so in male), apical margin slightly curved, more strongly in paraocular regions; eyes forming broadly rounded angle at dorsolateral margin; frontal shield with dorsal margin broadly arched with indentations below antennae and ventral ocellus, lateral margins gently curved, with distinct subantennal ridge; antennae longer than prothorax in male, shorter and finer in female.

Pronotum moderately elongate, more slender in male, supracoxal expansion distinct; lateral margins slightly lamellate, virtually smooth in male, finely denticulate in female; prozona dorsally with very fine scattered tubercules or smooth in some males, few more distinct tubercles ventrally; metazona smooth with faint mid-dorsal keel.

Fore coxa elongate, shorter than femur, anterior margin distinctly toothed; fore femur with 4 discoidal spines, the 2nd very short, the 3rd quite long, with 4 outer spines, the proximal pair closer together, and 15 inner spines, claw groove centrally located, ventral surface with scattered tubercles and slight depression anterior to the 4th discoidal spine; fore tibia with 8–9 outer and 13–14 inner spines. Mid and hind legs slender; femora without genicular spine or subapical lobe.

Macropterous in both sexes, wings as long as or longer than abdomen; tegmen with costal area and costal margin of discoidal area opaque, remainder hyaline; hind wing with costal area semi opaque, remainder hyaline.

Abdomen elongate, slender in male, broader in female; cerci of medium length, cylindrical,

distal segments slightly bead like. Male genitalia with dpr a strongly sclerotized bifurcate hook curved dextrad, medial lobe small but distinct; apr curved sinstrad and tapering to rounded tip, pa separated from vl by membranous area, ml elongate and finely hirsute; rph with dorsal arm partially sclerotized, aa elongate becoming squamiform sinstrally, vpl continuous with main body of phallomere, vspr compact u shaped.

Austromantis albomarginata Sjöstedt

Figures 1–8, 166

Iustromantis albomarginata Sjöstedt 1918: 28.
Iustromantis gracilis Sjöstedt 1918: 30. Syn. nov.

Material examined. Syntype male of *A. albomarginata*, "Kimberley district, N.V.Austr., Mjöberg, Febr., (221 89)". Syntype female of *A.albomarginata*, "Kimberley district, N.V.Austr., Mjöberg, Febr., (222 89)". Holotype male of *I.gracilis*, "Broome, V.Austr., Mjöberg, (223 89)" (All NHRM).

Other specimens examined (57♂, 8♀, 2 juv). Qld, 1 ♂, Barcaldine, 10 Feb 1981, ♂, 24 km N of Einasleigh, 31 Dec 1989, ♂, ♀, Mareeba, 7 Dec 1952, (All AM), ♂, Armstrong Ck Crossing, 13 km NNW of Guthalungra, 26 Jan 1982, ♂, 3 km SW of Barduthulla, 26 Dec 1961, ♂, 200 km SSW of Normanton, 14 Oct 1965, ♀, 5 km W of Maggieville HS, N of Normanton, 10 Apr 1962 (All ANIC), 2♀, Burke and Wills Junction 19°14′S, 140°21′E, 16 Jan 1993, 2♂, Dajarra Rd., 19 km SW of Cloncurry, 20°50′S, 140°23′E, 2 Jan 1993, ♂, Glenore Pumping Station, Norman River (17°51′S, 141°08′E), 13 Jan 1993, ♂, 16 km SE of Hann River Crossing, NW of Laura, 12 Jan 1990, ♂, Karumba, 7 May 1989 (all NMV), ♂, Normanton, 6 May 1963 (SAM), 2♂, Cloncurry, 8, 17 Apr 1947, ♂, Flinders River, 42 km SW of Normanton, 26 May 1972 (All UQ).

NT, ♂, 15 km SW of Alroy Downs HS 19°24′S, 135°58′E, 10 Apr 1976, ♂, 28 km SE of Anthony Lagoon 18°09′S, 135°44′E, 11 Apr 1976 ♂, Baroalba Ck Springs 12°47′S, 132°51′E, 19 km ENE of Mt Cahill, 28 Oct 1972, 2♂, 36 km SW of Borroloola 16°19′S, 136°05′E, 4 Nov 1975, 1juv, Bukalara Range, 46 km SSW of Borroloola 16°28′S, 136°10′E, 22 Apr 1976, ♂, 1 km N of Cahills Crossing, East Alligator River 12°25′S, 132°58′E, 31 Oct 1972, ♂, Caranbirini Waterhole, 33 km SW of Borroloola 16°16′S, 136°05′E, 21 Apr 1976, ♀, 17°29′S, 133°30′E, 8 km NNW of Elliot, 14 Oct 1972, ♂, McArthur River HS, 80 km SW of Borroloola, 13 May 1953, 2♂, 16°47′S, 135°45′E, McArthur River, 14 km SW of Cape Crawford, 25 Oct 1975, ♂, 12°50′S, 132°51′E, 16 km NE of Mt Cahill, 23 May 1973, ♂, 1231′S, 132°54′E, 9 km NE of Mudginberri HS, 30 Oct 1972, (All ANIC), ♂, Darwin, May 1977 (NMV), ♀, Groote Eylandt, Feb 1922, ♂, Lake Woods, 15 km SW of Elliot, 15 Oct 1977 (Both SAM), 2♂, Horn Islet, Sir Edward Pellew Group, 1–7 Feb 1968 (UQ).

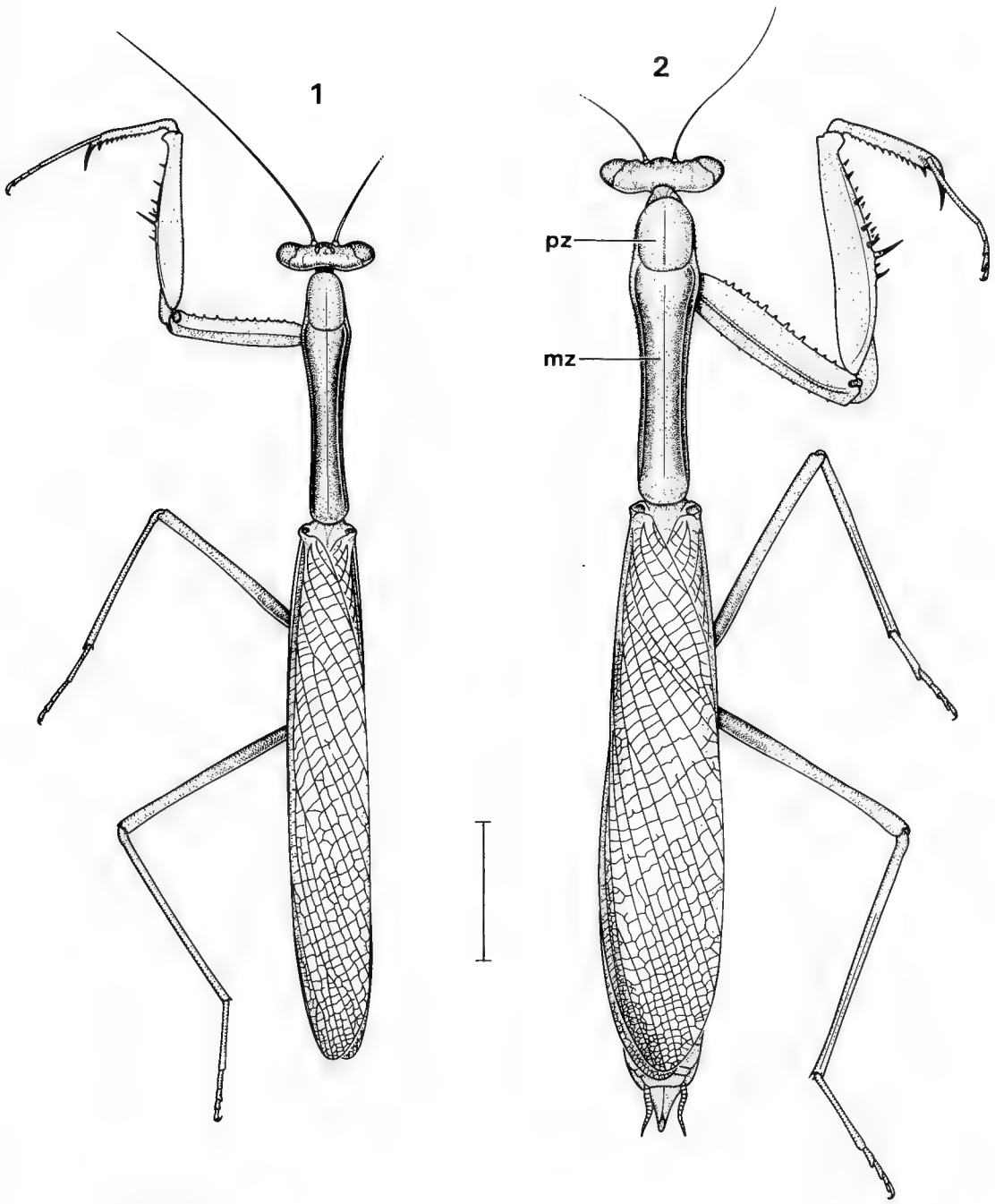
WA, ♂, Margaret River, 110 km WSW of Halls Creek, 8 Feb 1977 (AM), ♂, 1juv, 15°47′S, 128°40′E, Bandicoot Range, 7 km W of Kununurra, 7 May 1983, 2♂, 17°19′S, 122°10′E, 8 km S of Cape Bertholet, West Kimberley distr., 16, 17 Apr 1977, ♂, 17°17′S, 122°10′E, 5 km SSW of Cape Bertholet, West Kimberley dist., 21 Apr 1977, 3♂, Fitzroy River Crossing, Derby-Broome Rd, 3 Nov 1978, ♂, 15°46′S, 12844′E, Kununurra, 11 Apr 1985, ♂, 16°34′S, 122°49′E, 4 km WNW of Martins Well, West Kimberley dist., 20 Apr 1977, ♂, 21°34′S, 117°03′E, 3 km NW of Millstream HS, 5 Apr 1971 ♂, 21°35′S, 117°04′E, 1 km NNE of Millstream HS, 16 Apr 1971, ♂, 21°36′S, 117°07′E, 4 km ESE of Millstream HS, 31 Oct 1970, 2♂, 21°37′S, 117°06′E, 5 km SE of Millstream HS, 12 Apr 1971, 4♂, 21°35′S, 117°04′E, 2 km ENE of Millstream HS, 22, 30 Oct, 4 Nov 1970, 2♂, 21°35′S, 117°04′E, 1 km N of Millstream HS, 23, 28 Oct 1970, ♂, 21°35′S, 117°04′E, 0.5 km WNW of Millstream HS, 7 Apr 1971, ♀, 14°49′S, 125°42′E, Mitchell River Falls, Kimberley dist., 12 May 1983, ♂, 40 km ENE of Pardoo HS, Great Northern Hwy, 23 Nov 1973, ♀, 50 km SW of Sandfire Flat, Broome-Port Hedland Rd, 29 Oct 1978, (All ANIC), ♂, Kununurra, 7 Jul 1969 (NMV), ♂, Fortescue River, Hammersley Range (SAM), 2♂, Derby, 7 May 1964 (WAM).

Description. Body green; metazona of prothorax with margins and ventral surface purplish (reddish brown in dry specimens); inner face of fore coxa mauve posteriorly, yellow anteriorly (not apparent in dry specimens); femoral spines blackish brown, tibial spines tipped in blackish brown; proximal half of mid and hind femora yellow; costal area of tegmen with marginal white band and submarginal mauve and green bands, costal margin of discoidal area greenish; costal area of wing greenish; abdominal tergites 2–5 with central yellow patches, sternites 2–6 with black anterior margin.

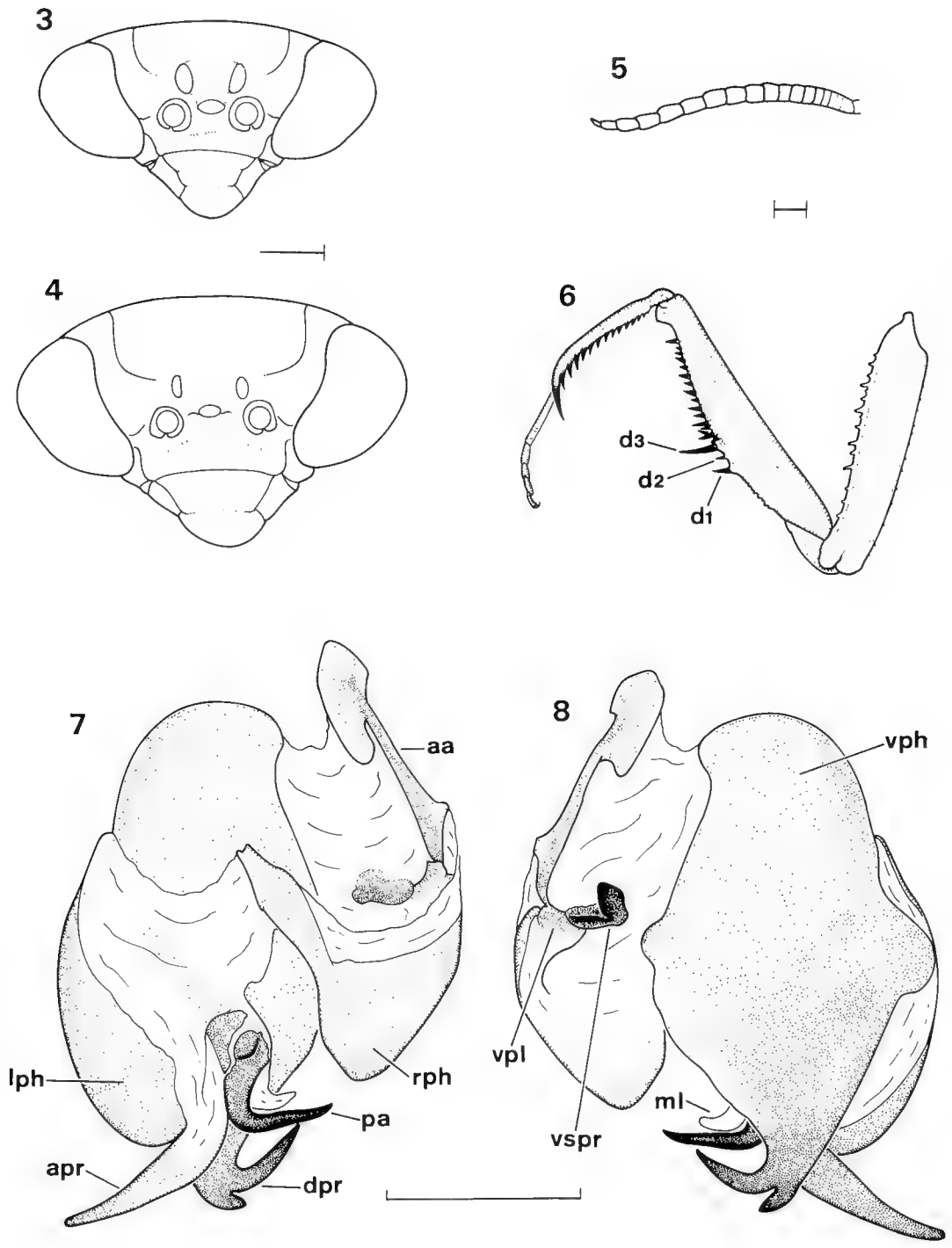
Male genitalia (figs 6, 7) with posterior arm of bifurcate dpr much shorter than anterior arm; apr elongate gently curved; pa rather smooth with elongate, narrow, pointed posterior process, sharply curved dextrad and small knob like anterior process, directed dorsad.

Measurements(mm). Body length, ♂ 50–62, ♀ 66–68. Head width, ♂ 6.5–7.7, ♀ 9.5. Head depth, ♂ 3.5–4.6, ♀ 6.8. Pronotum width, ♂ 3.0–4.4, ♀ 5.5. Pronotum length, ♂ 15.0–20.2, ♀ 23.1. Fore coxa length, ♂ 9.2–12.7, ♀ 17.1. Fore femur length, ♂ 11.0–15.4, ♀ 18.7. Tegmen length, ♂ 31.9–39.6, ♀ 40.7. Cercus length, ♂ 4.0–4.6, ♀ 6.1.

Immature stages. Nymphs similar in appearance to adults, ootheca unknown.



Figures 1–2. *Austromantis albomarginata*. 1, male; 2, female (pz = prozona, mz = metazona). Scale = 10 mm.



Figures 3–8, *Austromantis albomarginata*. 3, male head; 4, female head; 5, female cercus; 6, female foreleg, inside (d1–3 = discoidal spines 1–3); 7, male genitalia, dorsal (aa = anterior apodeme, apr = apical process, dpr = distal process, lph = left phallomere, pa = phalloid apophysis, rph = right phallomere); 8, male genitalia, ventral (ml = membraneous lobe, vph = ventral phallomere, vpl = ventral plate, vspr = ventral sclerotized process). Scales = 2 mm.

Distribution and habits. Known from the northern parts of Western Australia, Northern Territory and Queensland (fig. 166). I have collected this species from shrubs in northern Queensland. The large proportion of males in collections probably indicates that most specimens were collected at light traps.

Remarks. This species shows some variation in size. Sjostedt's type male of *A.gracilis* is at the small end of the range, however its genitalia are virtually identical to those of the male syntype of *A.albomarginata* examined.

Nullabora Tindale

Nullabora Tindale, 1923: 442. Type species *Nullabora flavoguttata* Tindale by monotypy.

Diagnosis. Head strongly anterio-posteriorly compressed, eyes tapering to blunt point, both sexes macropterous, cerci cylindrical and stout, dpr of male genitalia bifurcate.

Description. Body of medium size, rather slender, female more robust than male. Head at least twice as wide as high, strongly anterio-posteriorly compressed, slightly concave anteriorly, apical margin horizontal but curving downward little toward eyes; eyes tapering to blunt point at dorso-lateral margin; frontal shield transverse, about 3.5 times as wide as high, surface flat, dorsal margin broadly curved with indentations below antennae and ventral ocellus, lateral margins slightly curved; antennae of male slightly longer than prothorax, those of female finer and about half length of prothorax.

Pronotum elongate, slender, supracoxal expansion moderate; margins slightly lamellate, almost smooth in male, finely denticulate in female; prozona slightly constricted in both sexes, moderately tuberculate beneath; metazona with very faint mid dorsal keel.

Fore coxa slender, shorter than femur, anterior margin with 6–7 small blunt teeth interspersed by smaller denticles; fore femur slender, claw groove at or slightly distal of midpoint, with 4 discoidal spines, the 2nd shortest, the 3rd longest, with 4 outer spines and 16 inner spines, ventral surface with scattered tubercles and shallow depression anterior to 4th discoidal spine; fore tibia with 11 outer and 16 inner spines. Mid and hind legs slender, femora without genicular spine.

Macropterous in both sexes, wings as long as abdomen in female, slightly shorter in male, tegmen with costal area and costal margin of discoidal area opaque, remainder hyaline; hindwing with costal area semi opaque, remaider hyaline.

Abdomen elongate; cercus of moderate length, cylindrical and rather stout, terminal segment pointed. Male genitalia with dpr a sharply curved bifurcate hook; apr tapering to blunt point, slightly sinuate; dl of lph reduced; vsph small, stoutly u-shaped.

Nullabora flavoguttata Tindale

Figures 9–17, 166

Nullabora flavoguttata Tindale. 1923: 443.

Material examined. Holotype female , Kingoonya, S.Aust., R.Harvey, I.14070. Paratype nymph, Northern Territory, Capt.S.A.White (both SAM).

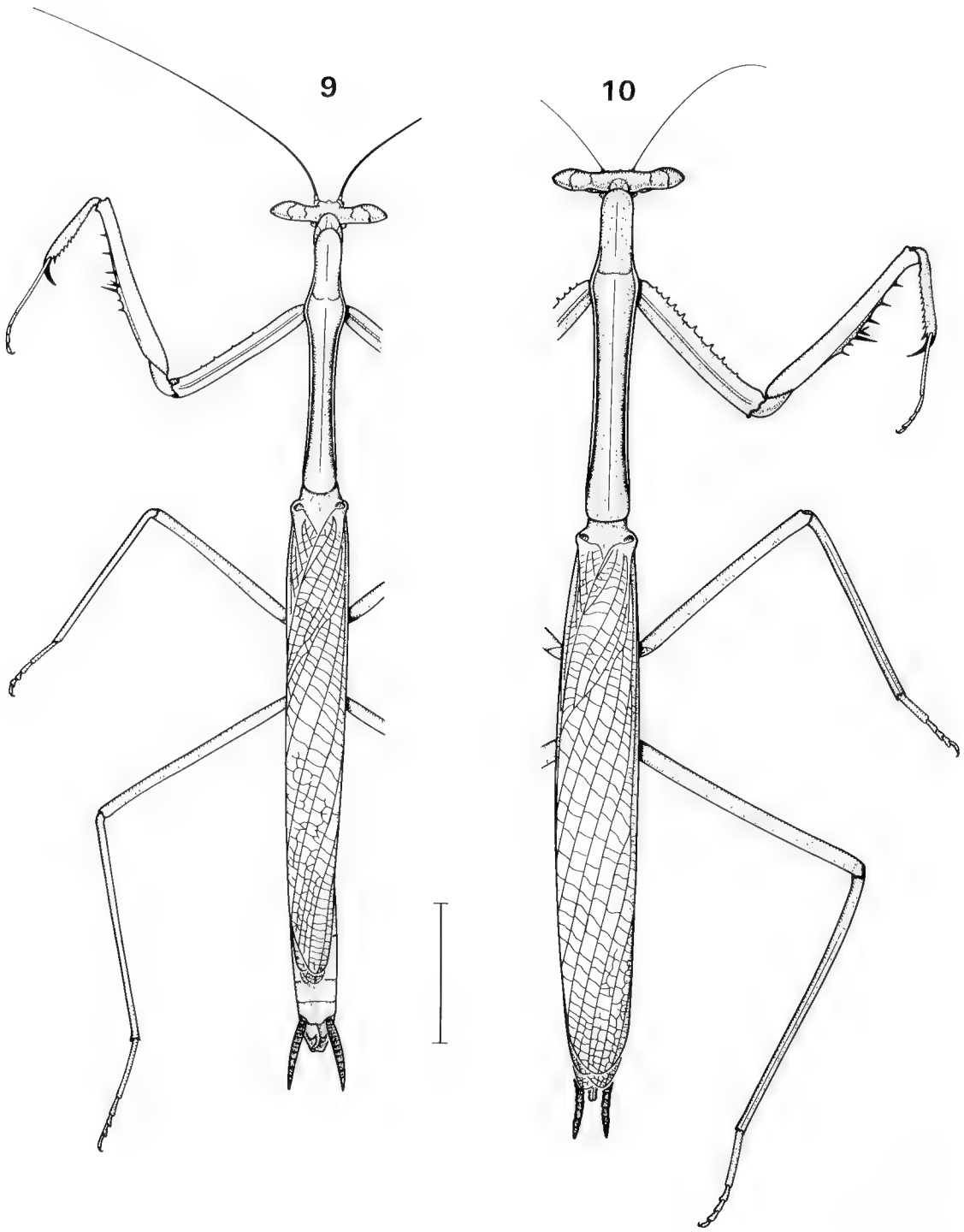
Other specimens examined (9♂, 14♀, 11 juv.). Qld. 2♂, ♀, Butcher Creek, 20 km W of Cloncurry, 21 Jan 1977 (AM). 1 juv., 48 km E of Camooweal, 24 Aug 1960. ♂, 21°41′S, 140°30′E, Selwyn Mine, 160 km SE of Mt Isa, 28 Dec 1991. ♀, 21°41′S, 140°30′E, Selwyn Mine, 160 km SE of Mt Isa, 17 Oct 1990. 1 juv., 17°24′S, 138°18′E, 9 km SSE of Westmoreland HS, 29 May 1975 (all ANIC). 2♂, ♂, 20°43′S, 140°21′E, Butcher Ck., 16 km W of Cloncurry, 1 Jan 1993. ♀, 19°17′S, 140°29′E, 16 km ESE of Burke and Wills Junction, 15 Jan 1993. ♀, 19°17′S, 140°27′E, Crocodile Ck., 14 km ESE of Burke and Wills Junction, 14 Jan 1993. ♂, 2♂, 1 juv., 20°50′S, 140°23′E, Dajarra Rd., 19 km SW of Cloncurry, 2 Jan 1993 (all NMV).

NT. ♀, 16°16′S, 136°05′E, Cararbirini Waterhole, 33 km SW of Borroloola, 21 Apr 1976. 1 juv., 19°51′S, 136°02′E, 14 km SSE of Dalmore Downs HS, 25 Apr 1976. ♀, 1 juv., 20 km S of Elliot, 19 Nov 1966. 1 juv., 20 km NNW of Renner Springs, 15 Oct 1969. 1 juv., 30 km E of Vaughan Springs HS, 25 Jul 1968 (all ANIC).

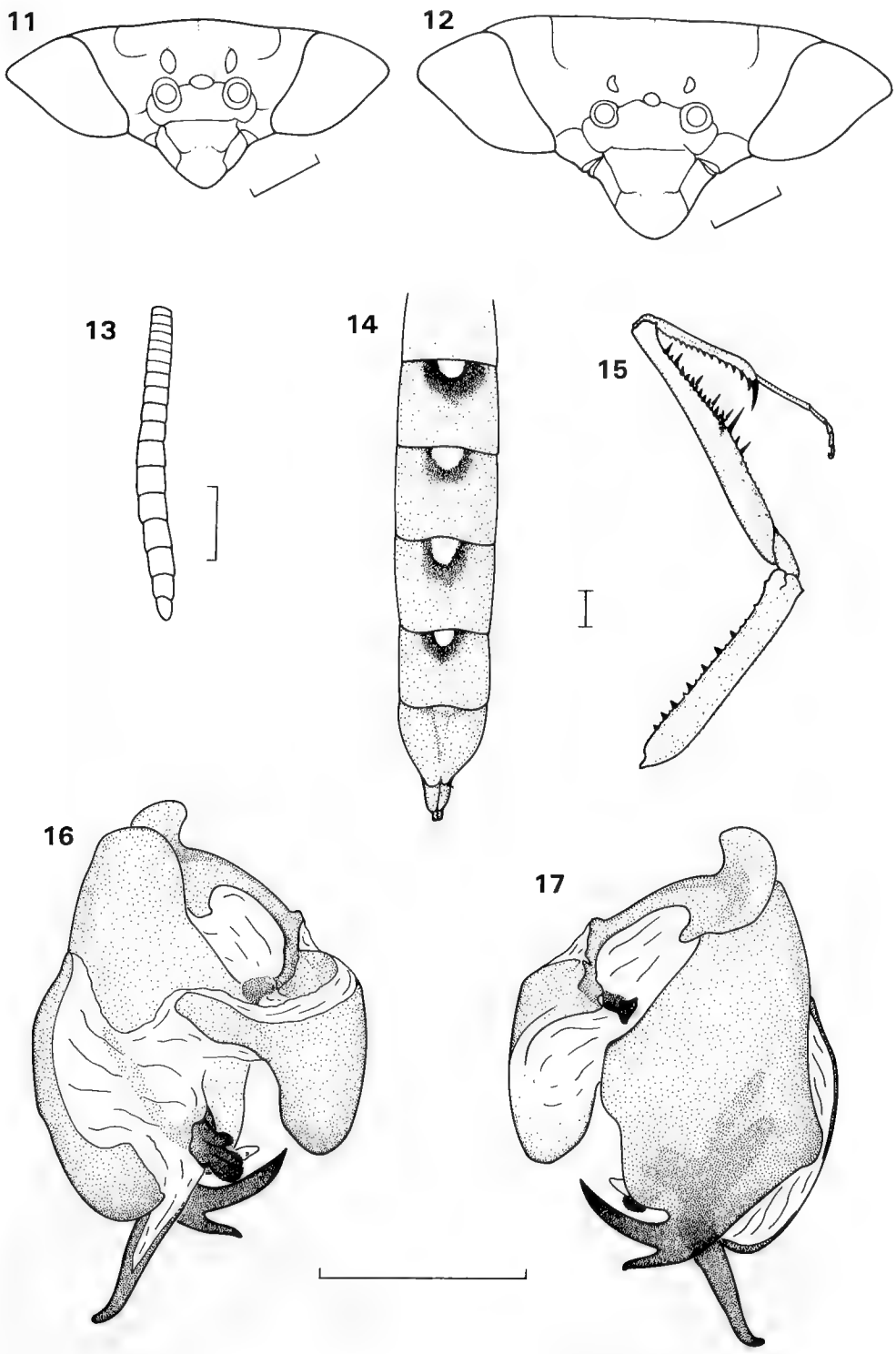
South Australia. ♂, 26°09′S, 130°35′E, 56 km W of Amata, Musgrave Ranges, 20–21 Jan 1982 (ANIC). ♂, Anna Creek HS, 6 Dec 1974 (SAM).

WA. ♀, 18°49′S, 123°17′E, 163 km ESE of Broome, 4 Aug 1976. ♀, 11 km ESE of Dandaraga HS, nr Sandstone, 23 Jan 1974. ♀, 9 km NW of Leonora, 19 Jan 1974. 1 juv., McSpeery Gap, Napier Range, SE of Kimberley Downs HS, 27 Oct 1969. ♀, 10 km E of Mt Thorlan, NW of Christmas Creek HS, 22 Oct 1969. 1 juv., 10 km E of Mt Thorlan, NW of Christmas Creek HS, 28 Oct 1969. 1 juv., 28°30′S, 115°45′E, 25 km NE of Mullewa, 17 Oct 1984 (all ANIC). 1 juv., Hogarth Well, Jul 1956 (SAM). ♂, 24°39′S, 128°45′E, Bungabiddy Rockhole, Walter James Range, 15–16 Jan 1990. ♀, 23°59′S, 117°32′E, Pingandy Station, 13 Mar. 1980 (all WAM).

Description. Dry specimens yellowish green. Face with broad whitish horizontal band; metazona of pronotum edged dorsally in reddish brown, white along mid dorsal line, almost completely reddish brown to black ventrally; inner face of fore coxa yellowish with anterior



Figures 9–10. *Nullabora flavoguttata*. 9, male; 10, female. Scale = 10 mm.



Figures 11–17, *Nullabora flavoguttata*. 11, male head; 12, female head; 13, female cercus; 14, female abdomen; 15, female foreleg, inside; 16, male genitalia, dorsal; 17, male genitalia, ventral. Scales = 2 mm.

marginal teeth black; inner face of fore femur yellowish in ventral half, femoral spines dark brown; fore tibia with spines tipped dark brown; meso and meta sternum reddish brown to black; costal area of tegmen with white outer band and green to purplish inner band, outer margin of costal area greenish, remainder of tegmen hyaline; costal area of hindwing yellow-green, remainder hyaline; abdomen with broad mid dorsal longitudinal band, purplish centrally and white to either side, ventrally (fig. 14) with large yellow patch bordered by reddish brown on mid anterior margin of sternites 2–6 (♂) or 2–5 (♀). Male genitalia (figs 16–17) with compact, strongly shagreened pa, consisting of smaller anterior and larger posterior knobs, the larger one with transverse furrow.

Measurements (mm). Body length, ♂ 60, ♀ 66–70. Head width, ♂ 8.6, ♀ 10.5. Head depth, ♂ 3.8, ♀ 4.6–4.8. Pronotum width, ♂ 2.6, ♀ 3.5. Pronotum length, ♂ 19.2, ♀ 25.2–25.9. Tegmen length, ♂ 34.1, ♀ 41.8. Fore coxa length, ♂ 12.1, ♀ 15.4. Fore femur length, ♂ 14.3, ♀ 16.5–17.6. Cercus length, ♂ 3.3, ♀ 5.0–7.2.

Immature stages. Nymphs similar in appearance to adults. Ootheca unknown for certain, however, I have collected oothecae from shrubs in which adults and nymphs were also taken and which probably belong to this species. The oothecae are small, globular and whitish in colour with an unusual flap-like structure overlaying the dorsal exit region.

Distribution and habits. Known from the drier parts of Queensland, Northern Territory, Western Australia and South Australia (Fig.166). I have collected this species from acacia shrubs in the Gulf country of Queensland.

Remarks. Despite being widespread this species is poorly represented in collections, perhaps indicating scarcity in nature.

Corthylomantis gen. nov.

Type species. *Corthylomantis baldersoni* sp. nov.

Diagnosis. Body of moderate size, elongate. Head about as wide as high, moderately compressed anterio-posteriorly, slightly concave anteriorly, apical margin curved toward paraocular regions; dorso-lateral margin of eyes rounded; frontal shield with dorsal margin broadly arched, identations below antennae and ventral ocellus, lateral margins slightly curved, with distinct subantennal ridge; antennae of male about as long as prothorax, of female about half the length of prothorax.

Pronotum elongate, more slender in male, supracoxal expansion distinct; lateral margins slightly lamellete, particularly around prozona and supracoxal expansion, only lightly denticuled in anterior half; prozona smooth dorsally in male, few scattered tubercles in female, lightly tubercled ventrally; metazona with distinct mid dorsal carina.

Fore coxa shorter than femur, with 6 or 7 small blunt teeth on anterior margin; Fore femur with 4 discoidal spines, the 2nd shortest, the 3rd longest, with 4 outer spines and 15 inner spines, claw groove centrally situated; Fore tibia with 14–15 inner and 8–10 outer spines. Mid and hind femora with small genicular spine.

Male macropterous, wings just surpassing 6th abdominal segment, tegmen with proximal third of costal area and costal margin of discoidal area opaque to subopaque, remainder hyaline, hindwing with costal area opaque, remainder hyaline. Female brachypterous, wings covering first 2 abdominal segments, tegmen completely opaque, hindwing subopaque.

Abdomen elongate, more slender in male; cerci short, distal segments only very slightly compressed laterally, tip of apical segment a rounded point. Male genitalia with dpr a strongly sclerotized hook curved dextrad, sometimes with small secondary spine near tip; medial lobe not prominent. Apr curved sinstrad and tapering to rounded tip; pa separated from vl of lph by membranous area; ml elongate, finely hirsute. Rph with dorsal arm partially sclerotized; aa elongate, squamiform sinstrad; vpl continuous with main body of rph; vspr compact, u-shaped.

Etymology. The first component of the generic epithet is derived from the Greek *korthylos* meaning little king or chieftain and relates to the derivation of the first component of *Archimantis* i.e. from *archon* meaning chief, ruler.

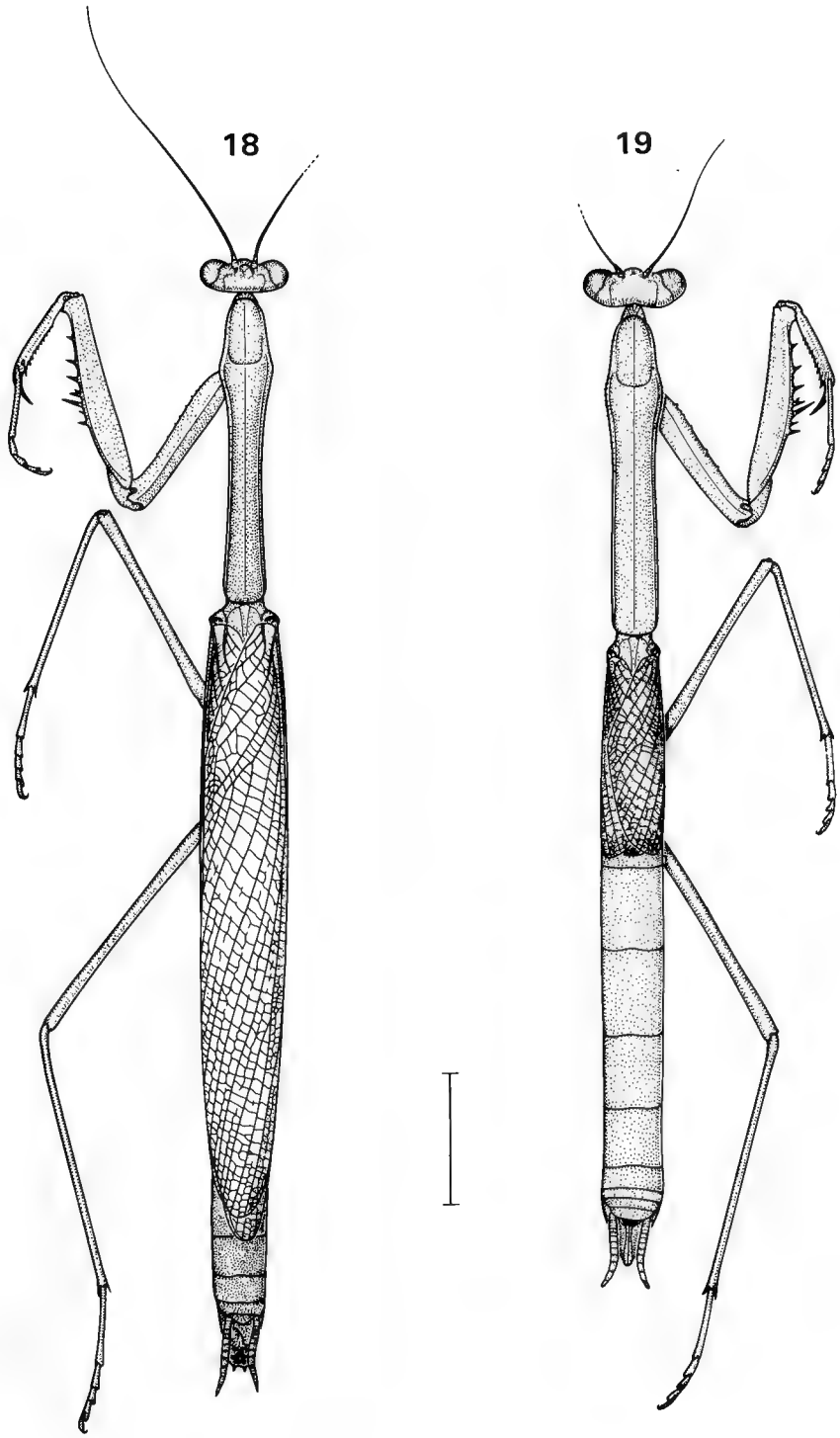
Corthylomantis baldersoni sp. nov.

Figures 18–28, 167

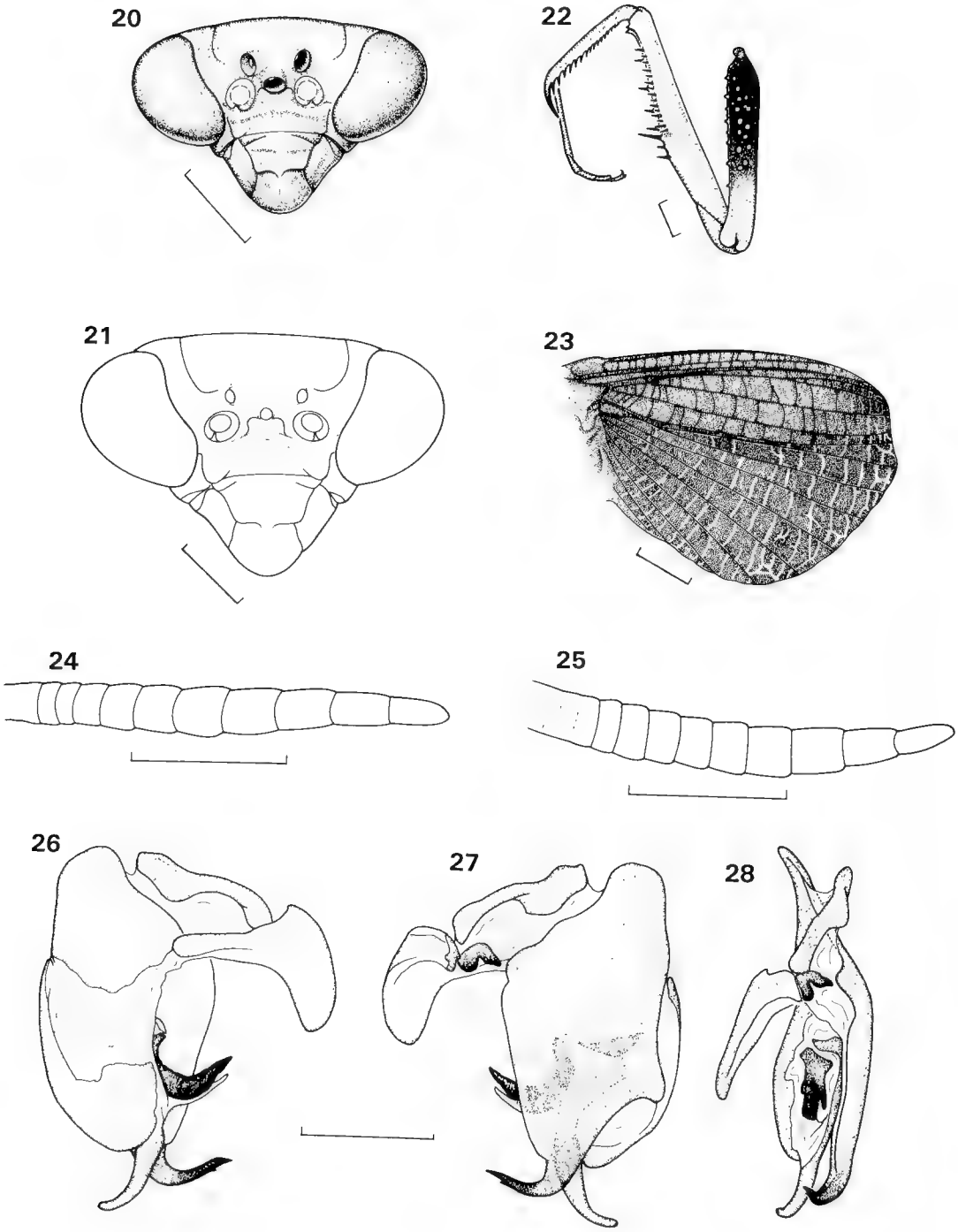
Material examined (2♂, ♀). Holotype: ♂, 15°43′S, 128°39′E, Valentine Rockhole, 12 km WNW of Kununurra, Western Australia, 8 May 1983, D.C.F.Rentz and J.Balderson, Stop 4 (ANIC).

Paratypes: ♂, 8.3 km SSW of Canobie HS, Queensland, 13 Apr 1962, K.H.L.Key and E.L.Corby (ANIC, 13565). ♀, 17°23′S, 124°44′E, Lennard River Crossing, Gibb River Road, Kimberley, Western Australia, Apr 1988, T.F.Houston 678–9 (WAM, 90/489).

Description. Body colour yellowish brown. Prosternum with dark colouration between bases of



Figures 18–19, *Corthylomantis baldersoni*. 18, male; 19, female. Scale = 10 mm.



Figures 20–28, *Corthylomantis baldersoni*. 20, male head; 21, female head; 22, male foreleg, inside; 23, female hindwing; 24, male cercus; 25, female cercus; 26, male genitalia, dorsal; 27, male genitalia, ventral; 28, male genitalia, right lateral. Scale = 2 mm.

fore coxae; inner face of fore coxa (fig. 22) pale distally, becoming darker with pale spots proximally; fore femur with inner face pale, 1st and 3rd discoidal and large inner spines entirely blackish brown, 2nd and 3rd discoidal, outer and small inner spines more or less tipped with blackish brown; inner face of tarsal segments some times blackish. Opaque areas of tegmen similar to body colour above, intense reddish brown beneath; hindwing of male with costal area brownish, remainder hyaline, hindwing of female (fig. 23) smokey black in colour, crossveins of discoidal area flushed white. Male genitalia (figs 126–128) with dpr rather narrow basally, apr only slightly swollen medially, anterior section of ventral lamina of lph small in area with short projection at junction with pa, pa a single uncinate dextrad projection, surface lightly ridged and shagreened.

Measurements (mm). Body length, ♂ 75–78, ♀ 70. Head width, ♂ 6.2, ♀ 7.5. Head depth, ♂ 5.4, ♀ 6.3. Pronotum length, ♂ 22.2–22.5, ♀ 24.5. Pronotum width, ♂ 3.6–3.7, ♀ 5.0. Fore coxa length, ♂ 11.6–11.8, ♀ 13.5. Fore femur length, ♂ 13.5–13.9, ♀ 15.5. Tegmen length, ♂ 40.5–43.5, ♀ 15.5. Cercus length, ♂ 5.7, ♀ 5.8.

Immature stages. Nymphs and ootheca unknown.

Etymology. This species is named for John Balderson for his contributions to the collection and study of Australian praying mantids.

Distribution and habits. Known only from 3 localities, 2 in north Western Australia and 1 from northwestern Queensland (fig. 167). The habits of this species are unknown, however, the female paratype has a small label attached stating the following, 'active in grass tussocks at night'.

Remarks. This appears to be a widespread but uncommon species.

Coenomantis Giglio-Tos

Coenomantis Giglio-Tos. 1917: 45. Type species *Pseudomantis kraussiana* Saussure, by monotypy.

Thorodia Tindale, 1923: 452. Type species *Thorodia melanoptera* Tindale, by monotypy.

Diagnosis. Male macropterous, female brachypterous, prothorax covered with scattered tubercles, discoidal area of hindwing pigmented, cerci short and stout.

Description. Body of medium size, moderately elongate. Head slightly wider than high, moderately anterio-posteriorly compressed, apical margin broadly arched, paraocular regions distinctly lower; eyes prominent, margins rounded; upper margin of frontal shield curved, with indentations below antennae and median ocellus, with distinct subantennal ridge, ventral margin broadly arched; antennae about the same length as pronotum in male, distinctly shorter in female.

Pronotum moderately elongate, with distinct supra coxal expansion; lateral margins distictly tuberculate in prozona, moderately tuberculate in metazona of female, almost smooth in metazona ef male, lamellate, especially around supracoxal expansion; dorsal surface with scattered tubercles, more distinct in female, metazona with distinct median keel; ventral surface with scattered tubercles, more distinct in female.

Fore coxa with small scattered tubercles on all surfaces, anterior margin with 4–5 teeth and number of smaller tubercles; fore femur with few small tubercles on all surfaces, 4 discoidal spines, 2nd very short, 3rd very long, with 4 outer and 13–14 inner spines, ventral surface with slight depression anterior to 4th discoidal spine; fore tibia with 7–9 inner and 13–14 outer spines; hind legs slender, with or without genicular spine, coxae with small lobe at ventolateral corner.

Male macropterous, female brachypterous, tegmen with costal area opaque, discoidal area opaque in female but only partially so in male, hindwing pigmented.

Abdomen moderately elongate, cerci short and stout with distal segments laterally compressed. Male genitalia with dpr of vph uncinate, apr elongate and tapering to blunt point, vspr u-shaped.

Coenomantis kraussiana (Saussure)

Figures 29–51, 167

Coenomantis kraussiana (Saussure), 1873: 25.

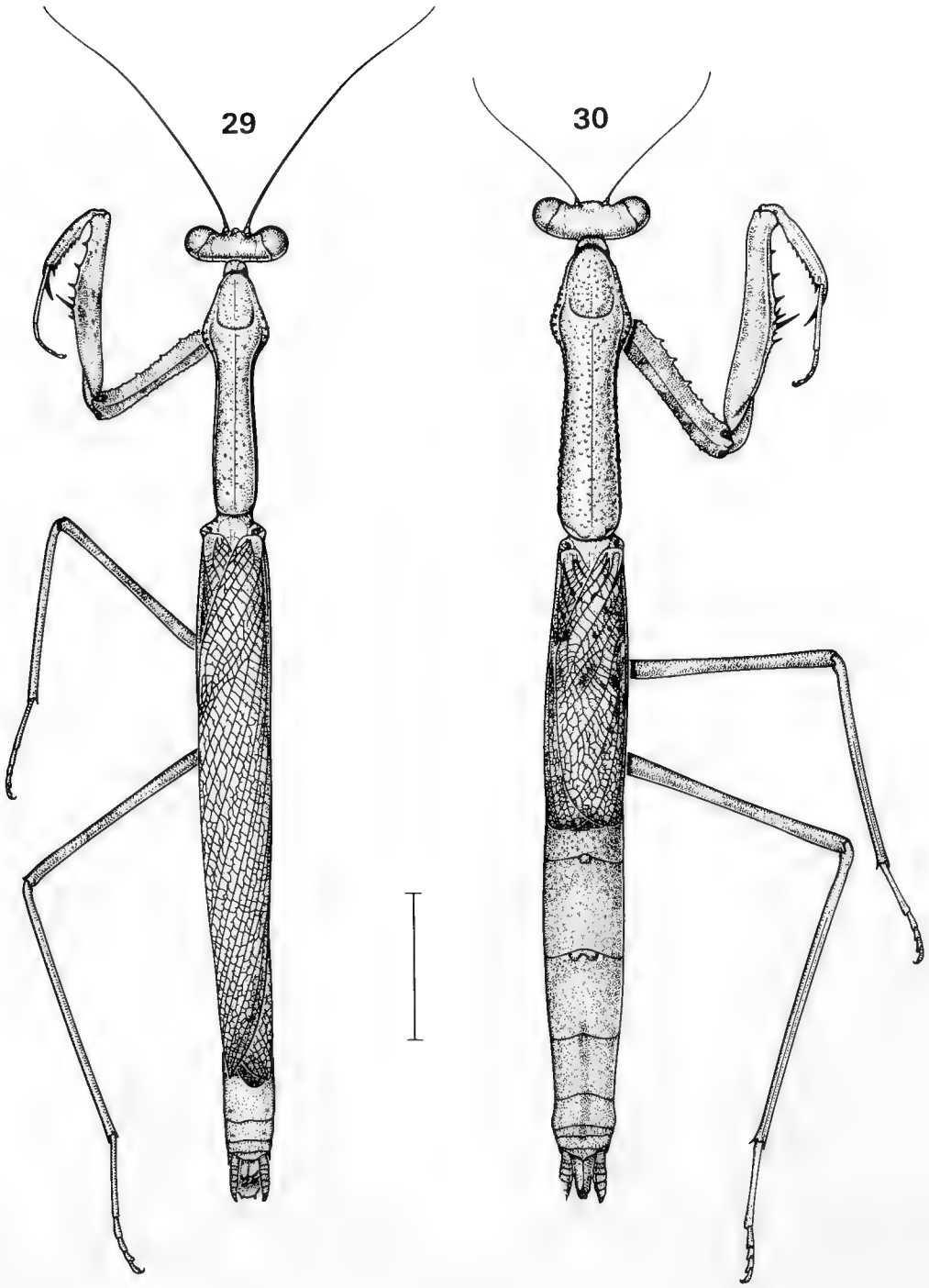
Thorodia melanoptera Tindale, 1923: 453. Syn. nov.

Thorodia melanoptera major Tindale, 1923: 453.

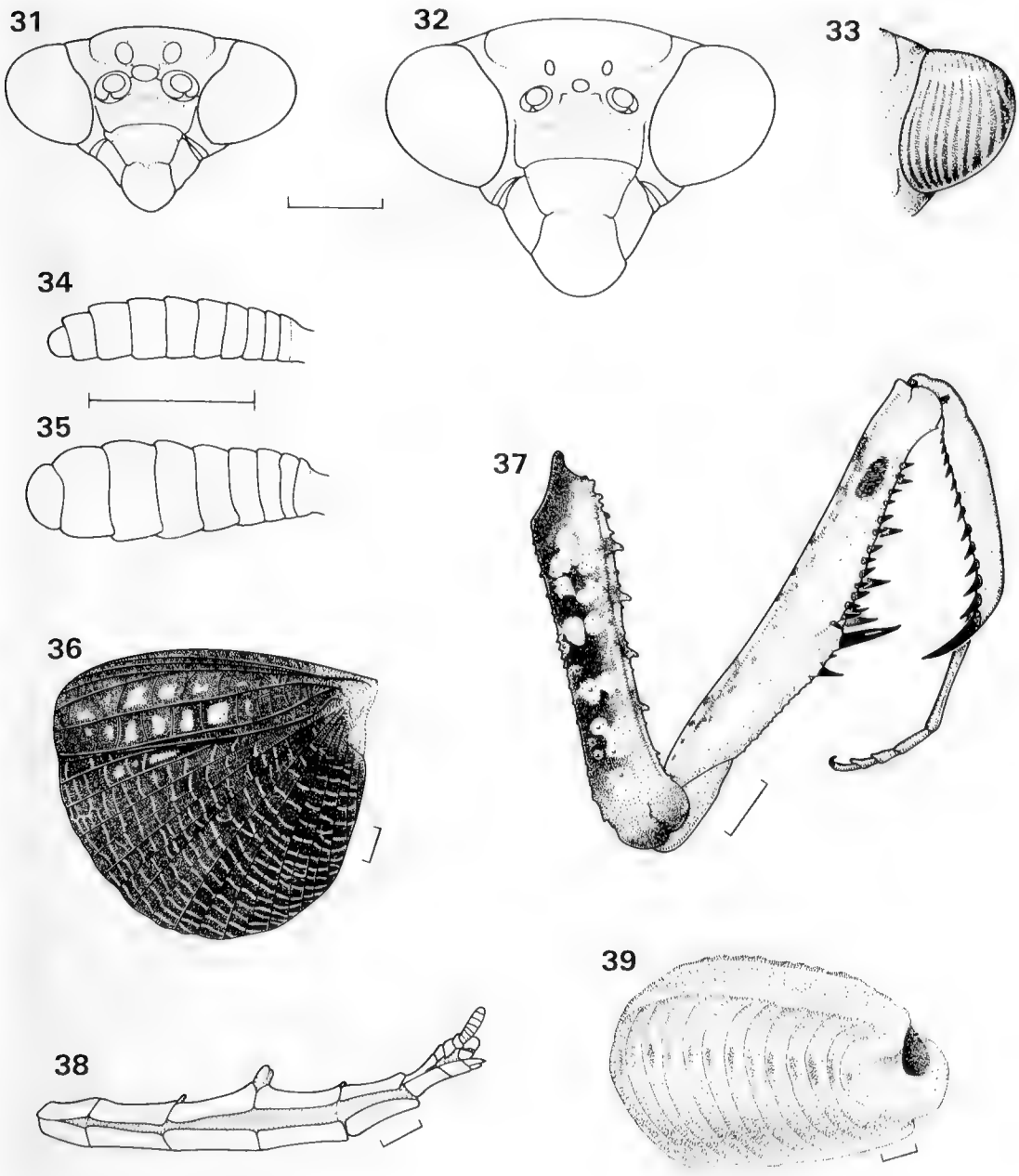
Material examined. Syntype male of *T.melanoptera*, Murray River, SA, H.S.Cope, I.14064. Syntype female of *T.melanoptera*, Mindarie, SA, I.14064. Syntype male and syntype female of *T.melanoptera major*, Kingoonya, SA, R.Harvey, I.14065. (All SAM).

Other specimens examined (163♂, 49♀, 27 juv.). Qld. ♂, 4 km SSW of Birdsville, 4 Dec 1974, 2♂, 28°13S, 150°17 E, 37 km N of Goondiwindi, 14 Apr 1982, 1 juv., 18 km N of Tara, 22 Mar 1962 (all ANIC), ♂, 10 km W of Etjabuka Stn, 3 Jun 1975 (NMV).

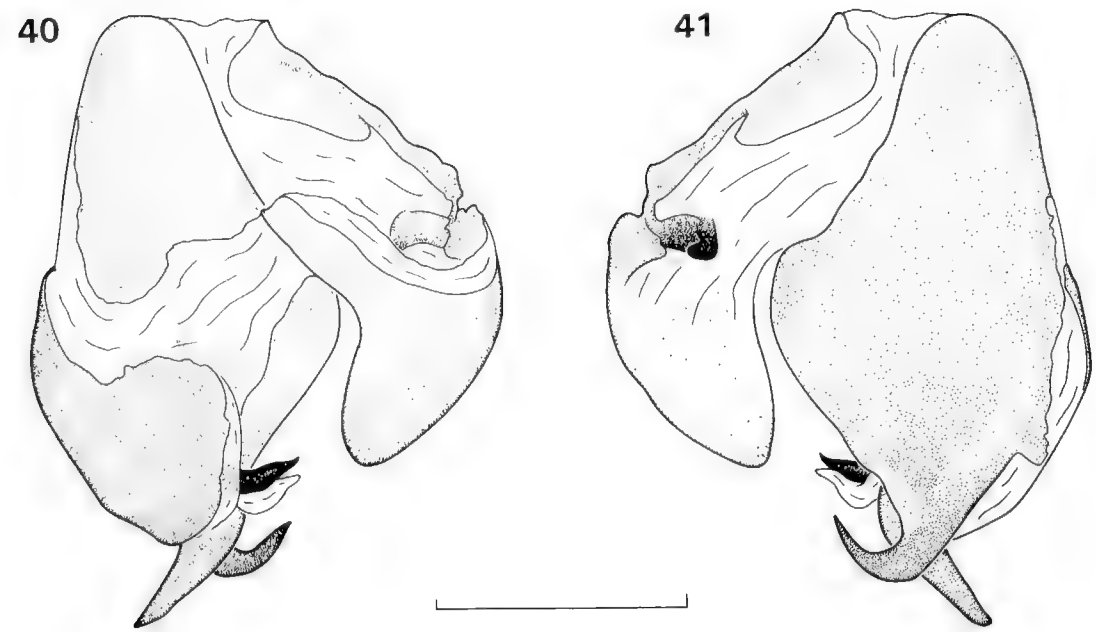
NSW, ♀, Brewarrina, May 1962, ♂, 33 km WSW of Coolabah, 2 Nov 1963, ♂, Round Hill Nature Reserve, 28 Dec 1976, ♂, Stephens Creek, 24 km ENE of Broken



Figures 29–30, *Coenomantis kraussiana*. 29, male; 30, female. Scale = 10 mm.



Figures 31–39, *Coenomantis kraussiana*. 31, male head; 32, female head; 33, female eye, colour pattern; 34, male cercus; 35, female cercus; 36, female wing; 37, female foreleg, inside; 38, mid instar nymph, lateral abdomen; 39, ootheca, dorso-lateral. Scale = 2 mm.

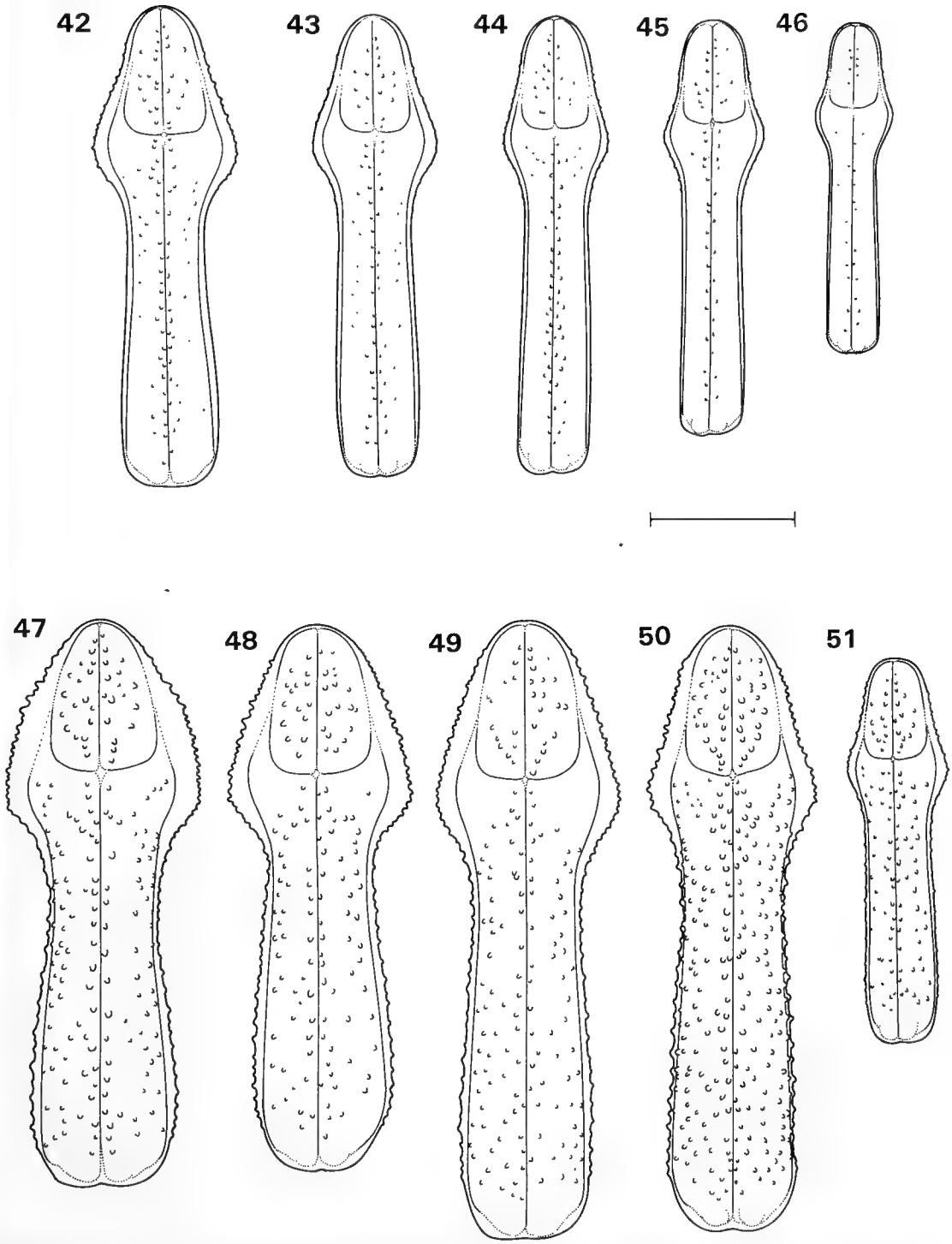


Figures 40–41. *Coenomantis kraussiana*. 40, male genitalia, dorsal; 41, male genitalia, ventral. Scale = 2 mm.

Hill, 28 Jan 1976 (all AM). ♂, 32°08′S, 149°00′E, 4 km WSW of Elong Elong, nr Mendooran, 2 Jan 1971. ♂, 31°05′′S, 14°142′E, Fowlers Gap Research Stn, N of Broken Hill, 1979–1981. ♂, Gilgandra, 17 Nov 1984. ♀, Lightning Ridge, 8 Jul 1977. ♀, 32°30′S, 140°20′E, Kinchega Nat Pk, Jan 1986. 2♂, Trangie Exp Stn, 6 km NW of Trangie, 13–21 Sep 1978. ♂, Wittabrenna Creek, 20 km N of Tibooburra, 2 Nov 1971. 4♂, Wittabrenna Creek, 20 km N of Tibooburra, 25 Mar 1972 (all ANIC). 2♂, ♀, 1 juv., 25 km S of Bourke, 21 Feb 1989. ♀, 5 km NNW of Silverton, 30 Jan 1990. ♀, 86 km N of Wentworth, 29 Jan 1990 (all NMV). ♂, Broken Hill, 10 Nov 1976. ♂, 25 km NE of Broken Hill, 10 Jan 1963. ♂, Broken Hill, 1 Dec 1906. ♂, Broken Hill, 10 Mar 1900. ♂, 16 km SW of Silverton, 16 Dec 1963 (all SAM).

NT. ♂, Alice Springs, 20–25 Apr 1955. ♂, 23°42′S, 133°53′E, Alice Springs, 1 Nov 1980. 10♂, 23°41′S, 133°52′E, Alice Springs, 6–8 Nov 1988. 2♂, 23°41′S, 133°52′E, Alice Springs, 3–4 Nov 1988. 3♂, 24°11′S, 133°31′E, Stuart Hwy, 65 km SSW of Alice Springs, 27 Oct 1988. ♂, Alice Springs, 17 Nov 1966. ♂, Alice Springs, 29 Sep 1955. 6♂, 23°41', 134°15 E, 39 km E of Alice Springs, 25–26 Sep 1978. ♂, 25°39′S, 134°38′E, 10 km SE of Finke, 30 Sep 1972. ♂, Gosses Bluff, 13 Apr 1969. ♂, 24°10′S, 135°24′E, Hale River Crossing, 7–8 Sep 1955. ♂, 24°36′S, 133°12′E, 7 km SW of Henbury HS, 2 Oct 1972. 3♂, 26°00′S, 131°25′E, 26 km WSW of Mulga Park HS, 18 Jan 1982. 2♂, 22°47′S, 136°18′E, Plenty Hwy, 268 km ENE of Alice Springs, 14 Oct 1978. 2♀, 60 km NW of Tanami, 13 Apr 1963. ♂, 25°21′S, 131°03′E, Uluru Motel, Ayers Rock, 4 Nov 1980. (all ANIC). ♂, Alice Springs, 27 Nov 1954. ♀, Kings Canyon Rd, 31 km W of Stuart Hwy, 1 Oct 1987 (all NMV). ♂, Anthony Well, 8 Aug 1930. 4♀, 1 juv., Double Punch Bowl, Henbury, 15 Oct 1985. ♀, Heavitree Gap, MacDonnel Ranges. ♂, Mulga Park HS, Oct 1960. ♂, Mount Liebig, Aug 1932. ♂, West tip Peterman Range 3 Oct 1963(all SAM).

South Australia. ♂, Innamincka, Coopers Creek, 24 Jan 1976. ♂, 27 km S of Innamincka, 28 May 1967 (both AM). 1 juv., Blinman, 16 Oct 1966. 1 juv., 40 km ESE of Burra, 28 Jul 1956. 1 juv., 20 km SE of Burra, 15 Aug 1961. ♂, Coopers Creek, 19 Oct 1949. ♂, Corny Point. ♂, 78 km W of Ernabella Mission, 30 Sep 1960. ♀, 33°30′S, 135°54′E, Hambidge Nat Pk, Eyre Peninnsula, 16–17 Dec 1970. 1 juv., 47 km NNE of Kingoonya, 16 Jul 1956. ♂, Lowan Station, 7 km S of Sherlock, 27 Dec 1954. ♂, 26°20′S, 134°56′E, 2 km SW of Mount Barr, SSE of Abminga, 25 Sep 1972. ♂, 32°17′S, 140°19′E, 25 km WNW of Olary, 20 Dec 1970. 1 juv., 26°07′S, 138°56′E, Old Alton Downs HS, WSW of Birdsville, 19 Sep 1972. 1 juv., 1.5 km E of Pimba, 13Jul 1956. 2♂, Slippery Dip Camp, Brachina Creek, 4, 9 Nov 1987. 1 juv., Tintinara, 17 Oct 1977. 4♂, 31°20′S, 138°37 E, Trezona Camp, Brachina Creek, 7 Nov 1987. ♂, 31°20 S, 138°37′E, Trezona Camp, Brachina Creek, 8 Nov 1987. 1 juv., 60 km NNW of The Twins HS, 17 Jul 1956. ♂, Watson, 22 Oct 1960. 2♂, 50 km SW of Whyalla, 20 Nov 1985 (all ANIC). 1 juv., Abminga Railway Stn, 22 Sep 1987. 5 juv., 5.5 km NNW of Alberrie Creek Railway Stn, 18 Sep 1987. 1 juv., 9 km SE of Bloods Creek Bore, 22 Sep 1987. 1 juv., Eringa HS, 190 km N of Oodnadatta, 21 Sep 1987. ♂, Halidon. ♂, Hesso, 3 Nov 1987. 2♀, 22 km W of Merna Morna HS, 16 Sep 1987. 1 juv., Moralana HS, 16 Sep 1987. 1 juv., Neales Creek, 3 km N of



Figures 42–51, *Coenomantis kraussiana*, dorsal prothorax. 42, male, Kingoonya, S.A. (syntype, *Thorodia melanoptera major*); 43, male, Alice Springs, N.T.; 44, male, 6 km NW of Trangie, N.S.W.; 45, male, Murray River, S.A. (syntype, *T.melanoptera*); 46, male, 2 km SW of Mt. Barr, S.A.; 47, female, Kingoonya, S.A. (syntype, *T.m.major*); 48, female, 20 km NE of Carnarvon, W.A.; 49, female, Kings Canyon Rd., 31 km W of Stuart Hwy., N.T.; 50, female, 13.6 km NW of Lascelles, Vic.; 51, female, 133 km NW of Oodnadatta, S.A. Scale = 5 mm.

Oodnadatta, 20 Sep 1987. ♀, 133 km NNW of Oodnadatta, 20 Sep 1987 (all NMV). ♂, Adelaide. ♀, Alford, 13 Jan 1892. ♂, Callimurra Waterhole, 11.3 km ENE of Innaminka HS, 31 May 1976. ♂, Cameron Corner, 16 May 1976. ♂, Coopers Creek, May 1925. ♂, Coopers Creek Ferry Crossing, 30 Nov 1977. ♂, Dalhousie Springs, 4 May 1976. ♂, Farina Creek, 30 May 1976. 2♂, Fowlers Bay. ♂, Henley Beach, Adelaide. 3♂, 2♀, Kingoonya. ♂, Koonalda Stn, Nullabor Plain, Jan 1955. ♂, Koonalda, 5 Jan 1960. ♂, Lake Eyre, 13 May 1963. 2♂, Lucindale. 7♂, Madigan Gulf, Lake Eyre, Nov 1966. 5♂, Madigan Gulf, Lake Eyre, 16 Feb 1956. ♂, Lameroo. 5♂, Marree Picnic Ground, 2 Nov 1955. ♀, Mereenie Bluff. 2♂, 32°57′S, 137°24′E, Middleback Stn, 1 Oct, 25 Nov 1983. ♀, Mindarie. ♀, Mernmerna HS, 1949. 2♂, Mudla Bore, 38 km NE of Billa Kalina HS, 4 Dec 1974. ♂, ♀, Murray River. ♂, New Kalamurina Stn, Warburton Range, 10 Mar 1972. ♂, Nth Prescott Point, Madigan Gulf, Lake Eyre, 2 Nov 1965, 1 juv., Old Billa Kalina Ruins, 4 Dec 1974. ♂, Olympic Dam Site, 2–5 Nov 1987. ♀, Ooldea. ♂, Owieandana, N Flinders Range, Nov 1924. ♀, Pimba. ♂, Poole Creek, 42 km W of Marree, 29 Sep 1989. 1 juv., Port Arthur, 22 Apr 1968. ♂, Port Augusta. ♀, Purple Downs, 267 km NW of Port Augusta. 2♂, 18 km S of Radium Hill, 30 Oct 1962. 2♂, Salt Creek, Coorong, 16 Nov 1967. 2♂, Simpson Desert, Jul-Aug 1972. ♂, Strezlecki Creek Crossing, 15 km SW of Tinga Tingana, 8 May 1976. ♂, Talaculanna Waterhole, 2 Dec 1964. ♂, West of Welbourne Hill, 24 Oct 1953. ♂, White Wells Reserve, 12 Jan 1960. ♂, Wirreandah Creek Crossing, 30 km S of Hawker, 26 Nov 1975. ♂, Woomera Village, 2 Dec 1961. ♂, ♀, Yurga, Dec 1955 (all SAM). ♂, Ettaduna Stn, Birdsville Track, 3 Oct 1972. ♂, 5 km NE of Kitto Kittalooloo Foreshore, 5 Aug 1971. ♀, western mid shore of Lake Palankarinna, Aug 1971 (all WAM).

Western Australia. ♀, 20 km SSW of Boologooro HS, NE of Carnarvon, 16 Sep 1961, 1 juv., 29°49′S, 114°59′E, 27 km W of Encabba, 9 Sep 1981. ♂, 11 km N of Geraldton, 13 Dec 1972. ♂, 30°45′S, 121°28′E, Kalgoorlie, 17 Jan 1978. 2♂, Learmonth, Exmouth Gulf, 17 Sep 1961, 1 juv., 31°57′S, 126°42′E, 32 km SW of Madura, 8 Oct 1968. ♂, 57 km ENE of Pardoo HS, ENE of Port Hedland, 18 Apr 1963. 1 juv., 33°24′S, 120°12′E, 27 km NNE of Ravensthorpe, 16 Nov 1969 (all ANIC). ♀, Norseman, Oct 1906 (NMV). 2♂, 31°26′S, 123°33′E, Buningonia Springs, 18–25 Nov 1978. ♂, 1.5 km E of Lake Ngapakaldi, 2 Jul-2 Aug 1971 (all WAM).

Victoria. ♀, Camel Pad Lake, Hattah Lakes Nat Pk, 24 Jan 1986. ♀, 35°56′S, 141°40′E, Chinamans Well, Big Desert, 11–14 Dec 1984. ♂, 34°12′S, 141°35′E, 8.8 km N of Cullulcraine, 17 Nov 1985. ♂, 34°12′S, 141°36′E, 8.2 km N of Cullulcraine, 14 Nov 1985. 2♂, ♀, Hattah Lakes Nat Pk, 21 Oct 1982. 2♀, 34°48′S, 142°07′E, 15.5 km WSW of Hattah, Jan 1986. ♀, 34°50′S, 142°07′E, 17 km SW of Hattah, 21 Jan 1987. ♂, Irymple, 12 Dec 1955. ♂, Kewell, Western District, April 1888. ♀, 3 km ENE of Lake Wallawalla, 20 Feb 1986. ♀, 34°09′S, 141°08′E, 5 km NW of Lake Wallawalla, 20 Nov 1985. ♀, 35°33′S, 142°26′E, 15.2 km NW of Lascelles, 21 Jan 1987. ♀, 35°31′S, 142°28′E, 14.9 km NW of Lascelles, 23 Jan 1987. ♀, 13.6 km NW of Lascelles, 20 Jan 1987. ♂, ♀, 34°48′S, 142°22′E, Lendrook Plain, 9 km SE of Hattah, 23 Oct 1985, 1 juv., 34°45′S, 141°04′E, 3.7 km N of Millewa South Bore, Feb 1986. 2♂, 34°36′S, 141°03′E, 19.4 km N of Millewa South Bore, 13, 14 Nov 1985. ♀, 34°50′S, 142°33′E, 7.8 km SW of junction of Murray Valley Hwy and Annuello Rd, Jan 1987. ♀, 35°25′S, 141°10′E, 16.8 km SSW of Murrayville, 23 Feb 1987. ♂, Ouyen, Nov 1914. ♂, 35°13′S, 143°19′E, 21.3 km NE of Patchewollock, 29 Jan 1987. ♀, 5.7 km N of Round Swamp, Big Desert, Mar 1985. ♀, 21.3 km W of Sunset Tank, 19 Nov 1987 (all NMV).

Description. Body grey-brown with numerous paler and darker blotches and spots giving the appearance of woody material. Inner face of fore coxa (fig. 37) and ventral surface of metazona of pronotum with large pale spots, femoral spines blackish, eyes finely striped (fig. 33). Tubercles on ventral surface of metazona elongate in some specimens, lamellate margins of pronotum of variable width anteriorly. Tegmina of male extend to just short of tip of abdomen, costal area and anterior part of discoidal area opaque brown above, black and reddish brown below, remainder virtually hyaline. Tegmina of female reaching posterior margin of 2nd abdominal segment, colour similar to male but discoidal area completely opaque and anal area smokey grey with pale cross veins. Wings (fig. 36) with costal, discoidal and anal area smokey brown to black with bluish sheen; discoidal area with extensive to almost absent transparent patches between cross veins; anal area with whitish cross veins. Abdomen with distinct to not obvious bilobate intersegmental projections along mid dorsal line between abdominal segments 2–6; anterior margin of sternites 2–6 blackish. Male genitalia (figs 40–41) with pa a single caudally directed uncinate projection, curving ventro-laterally toward distal end, margins rather uneven, occasionally with small ventral projection about mid point.

Measurements (mm). Body length, ♂ 45–69, ♀ 45–62. Head width, ♂ 4.2–6.5, ♀ 5.8–7.4. Head depth, ♂ 3.3–4.3, ♀ 3.8–5.4. Pronotum length, ♂ 11–17, ♀ 12–19. Pronotum width, ♂ 2.4–4.8, ♀ 3.4–6.4. Fore coxa length, ♂ 7.0–10.5, ♀ 7.6–11.0. Fore femur length, ♂ 7.5–12.7, ♀ 9.0–14.0. Tegmen length, ♂ 29–42, ♀ 13–23. Cercus length, ♂ 2.5–3.9, ♀ 3.0–4.0.

Immature stages. Nymphs similar in appearance to adults, dorsal abdominal projections more distinct (fig. 38); ootheca (fig. 39) of moderate size, dirty cream in colour, outer spongy layer very thin to moderate in depth, eggs arranged in u-shape.

Distribution and habits. Found in the drier regions of all mainland states of Australia (fig. 167). Individuals are most commonly found close to the ground in small woody shrubs where they are excellently camouflaged. Oothecae can be found attached to the stems of these shrubs and are often parasitised by wasps of the genus *Podagrion*. Adults are usually collected from spring to early summer. Occasional runt sized adults are found, probably resulting from growth under conditions of food shortage.

Remarks. The holotype of this species cannot be found (Balderson, 1984). Tindale (1923) described two subspecies of *Thorodia melanoptera* which Beier (1935) later elevated to species level without giving reasons. After examination of a large number of specimens I find that the pronotal variation used by Tindale as the basis for distinguishing the subspecies shows a gradual range of variation (figs 42–51), also the male genitalia of the type specimens of *T.melanoptera* and *T.m.major* show no significant difference. Therefore I consider these taxa synonomous.

Austrovates Sjöstedt

Austrovates Sjöstedt, 1918: 35. Type species *Austrovates variegata* Sjöstedt, by monotypy.
Heterarchimantis Werner, 1922: 121. Type species *Heterarchimantis lobata* Werner, by monotypy.

Diagnosis. Body elongate, male macropterous, female brachypterous, mid and hind legs with small subapical lobe, cerci with distal segments laterally compressed.

Description. Large, elongate and stick-like in form; male macropterous, female brachypterous. Head wider than high, anterio-posteriorly compressed, concave anteriorly, apical margin slightly arched; eyes prominent, margins rounded; frontal shield transverse, apical margin slightly arched and strongly indented below antennae and ventral ocellus, lateral margins sinuate, with distinct subantennal ridge; antennae little shorter than pronotum in male, distinctly shorter in female.

Pronotum elongate and slender, supracoxal expansion small but distinct; lateral margins slightly lamellate, finely tuberculate in prozona, same to almost smooth in metazona; prozona slightly constricted laterally in centre, few scattered tubercles dorsally, more distinctly tuberculate below; metazona with distinct mid dorsal keel and few scattered tubercles dorsally.

Fore coxa elongate, slender, anterior margin with 4–5 small teeth, inner face finely tuberculate; fore femur elongate, slender, slightly sinuous, 2nd discoidal spine shortest, 3rd longest, 4 outer and 14–16 inner spines, ventral face with slight depression anterior to 4th discoidal spine; tibia with 10 outer and 14–15 inner spines; mid and hind legs slender with small subapical lobe on inner margin of femur, genicular spine present or absent, genicular lobes produced into point; mid and hind coxae with small subapical lobe at ventro-lateral corner.

Abdomen elongate, slender; cerci slightly to markedly elongate, distal segments laterally compressed. Male genitalia with 2 semicircular membranous areas on right lateral margin of vph, dpr a sharply curved hook; dl of lph extensive, apr elongate and tapering to blunt point; vspr u-shaped.

Austrovates variegata Sjöstedt

Figures 52–53, 56–58, 60–66, 168

Austrovates variegata Sjöstedt, 1918: 36.
Heterarchimantis lobata Werner, 1922: 121.

Material examined. Syntype female of *A.variegata*, "Noonkanbah, N.V.Austr., Mjöberg, Dec., 224 89" (NHRM). Holotype female of *H.lobata*, Port Darwin (N. Territory), N.Holl. (Australia), V.Bemm (RL).

Other specimens examined (26♂, 16♀, 23 juv.). Qld. ♂, Almaden, Chillagoe dist., Jan 1932. ♂, Bee Creek, 25 km SW of Nebo, 6 Feb 1981. ♂, Capella, 8 Feb 1981 (all AM). 1 juv., 8 km E of Dunbar HS, 10 Oct 1975. ♂, Longreach, Jan-Mar 1972. ♂, ♂, Longreach, 20–31 Jan 1972. 1 juv., Normanton, 13 Aug 1984. ♂, 21°41′S, 140°30′E, Selwyn Mine, 160 km SE of Mt Isa, 23 Jan 1990 (all ANIC). ♂, 2♀, 19°14′S, 140°21′E, Burke and Wills Junction, 16 Jan 1993. 1 juv., 20°43′S, 140°21′E, Butcher Ck., 16 km W of Cloncurry, 1 Jan 1993. ♂, 20°51′S, 140°23′E, Dajarra Rd., 19 km SW of Cloncurry, 2 Jan 1993. 2 juv., 12 km E of Georgetown, 11 Apr 1991. ♀, 4.5 km N of Georgetown, 12 Apr 1991. 1 juv., 6 km N of Georgetown, 11 Apr 1991. ♀, 17°51′S, 141°08′E, Glenore Pumping Station, Norman River, 13 Jan 1993. 2♀, 17°44′S, 141°05′E, 6 km S of Normanton, 10 Jan 1993 (all NMV). ♂, Eidsvold (QM). ♂, Barcaldine, 6 Jan 1974. ♂, Cunnumulla, 26 Dec 1973 (all SAM).

Key to species of *Austrovates* (males)

1. Tegmen with distinct white marginal band, cerci about same length as subgenital plate ..... *A.papua*
— Tegmen without white marginal band, cerci about twice as long as subgenital plate ..... *A.variegata*

NT. ♂, Nhulunbuy, Feb 1973. ♀, Oenpelli, East Alligator River, 16 Oct 1948 (both AM). ♂, 11°09′S, 132°09′E, Black Point, Cobourg Peninsula, 30 Jan 1977. ♂, 12°25′S, 132°58′E, 1 km N of Cahills Crossing, East Alligator River, 29 May 1973, 1 juv., 19°51′S, 136°02′E, 14 km SSE of Dalmore Downs HS, 25 Apr 1976. ♀, Daly River Mission, 13–23 Jan 1974, 1 juv., 14°13′S, 130°55′E, 57 km WNW of Dorisvale HS, 11 Sep 1968, 1 juv., Katherine River Gorge, 18 Aug 1960. ♂, Koongarra, 15 km E of Mount Cahill, 26 Apr 1974, 2 juv., 16°39′S, 135°51′E, McArthur River HS, 80 km SW of Borroloola, 13 May 1973, 1 juv., 12°40′S, 132°54′E, Magela Creek, 9 km SSE of Mudginberri HS, 25 May 1973. ♂, 11°07′S, 132°08′E, Smith Point, Cobourg Penninsula, 14 Nov 1977. ♂, 14°31′S, 132°22′E, Tindal, 13 km ESE of Katherine, 6 Dec 1967. ♂, Victoria River Roadhouse, 21 Apr 1982 (all ANIC). 1 juv., nr Adelaide River, Jul 1963. ♂, 2 juv., Darwin, 1 juv., 4♀, Roper River, 1 juv., Stapleton, 2♀, Tennant Creek (all SAM).

WA. 2♂, Broome, 5 and 9 Nov 1978. ♂, Broome, 21 Sept 1973. 2♂, 42 km ESE of Broome, 16 Apr 1969, 1 juv., 14°49′S, 126°49′E, Carson Escarpment, Kimberley dist., 9–15 Aug 1975, 1 juv., 15°02′S, 126°55′E, Drysdale River, Kimberley dist., 3–8 Aug 1975, 1 juv., 14°53′S, 126°09′E, 5 km NW of King Edward River Crossing, Kimberley dist., 19 May 1983, 1 juv., 14°45′S, 125°47′E, 10 km NNW of Mining Plateau 17 May 1983, 1 juv., 14°49′S, 125°42′E, Mitchell River Falls, Kimberley dist., 12 May 1983. ♂, Mount Tom Price, Jan-Feb, 1967. ♀, Wyndham, 21 Jan 1930 (all ANIC). ♀, Crab Creek, E of Broome (SAM). 1 juv., Burma Rd. Reserve, 30 km E of Walkaway, Sep 1986, 1 juv., Hancock Gorge, 15 km S of Wittenoom, 15 May 1980. ♂, Town Point, Barrow Island, 9 Sep 1973, 1 juv., Wotjulum, Sep 1955 (all WAM).

Diagnosis. Cerci much longer than subgenital plate; male without white marginal band on tegmen, with wings covering first 5½ abdominal segments and dpr narrow and strongly recurved.

Description. Body brown with darker spots and blotches; eye with fine striped pattern; inner face of fore coxa rather darker proximally with pale tubercles and darkish apical band; tegmen of male with ventral portion of costal area blackish proximally and whitish distally with black veins, costal margin of discoidal area flushed brown except for transparent stigma bounded at either end by a dark patch, remainder hyaline; tegmen of female similar but opaque portion of discoidal area more extensive; hindwing with costal area dark brown, more so apically, remainder hyaline, Wings reaching or just surpassing posterior margin of abdominal segment 5 in male, segment 4 in female; cerci elongate (fig. 60–61), distal segments broadened and laterally compressed, apical segment with margin rounded and sometimes with slight notch below apex; anterior margin of abdominal sternites 2–5 blackish; antennae of male about two thirds the length of pronotum. Male genitalia (fig. 65–66) with dpr of vph a strongly curved elongate hook, slightly sinuous distally; pa smooth with single elongate pointed projection curving laterally.

Measurements (mm). Body length, ♂ 92–94, ♀ 96–100. Head width, ♂ 6.5–8.3, ♀ 8.5–9.2. Head depth, ♂ 3.7–4.2, ♀ 5.0–5.5. Pronotum width, ♂ 3.1–3.6, ♀ 4.4–4.6. Pronotum length, ♂ 25.5–31.5, ♀ 34.3–36.9. Fore coxa length, ♂ 10.8–14.9, ♀ 17.2–17.8. Fore femur length, ♂ 13.0–16.7, ♀ 20.0–20.7. Tegmen length, ♂, 38.5–44.4, ♀, 38.1–44.0. Cercus length, ♂ 4.6–7.0, ♀ 6.2–7.9.

Immature stages. Nymphs similar in appearence to adults but possessing mid dorsal intersegmental abdominal nodes (fig. 63). Ootheca (fig. 64) elongate, brown and whitish, with insubstantial outer foamy layer and sometimes thin projection at posterior tip of dorsal exit line. The ootheca is dissimilar to those presently known for other Archimantini.

Distribution and habits. Found in the northern parts of Queensland, Northern Territory and Western Australia (fig. 168). I have collected this species from shrubs and small trees in open woodland country in central north Queensland. Although females have reduced wings they are capable of at least short flights.

Austrovates papua sp. nov.

Figures 54–55, 59, 67–68, 168

Material examined. Holotype male, Doveta, Amazon Bay area, New Guinea, 2400 ft, 24 Jul 1962, W.W.Brandt (ANIC).

Diagnosis (male only). Cerci about same length as subgenital plate, tegmen with white marginal band, wings covering first 6½ abdominal segments, genitalia with dpr broad and weakly recurved.

Description (male only). Body of dry specimen dark brown with darker and paler blotches and spots, inner face of fore coxa dark with numerous pale tubercles; costal area of tegmen with outer white band, which diminishes distally and inner blackish band, costal margin of discoidal area cream in proximal quarter with dark spot at proximal end of stigma and dark brown distally, remainder of tegmen hyaline; hindwing with costal margin blackish brown, remainder hyaline; wings surpassing caudal margin of sixth

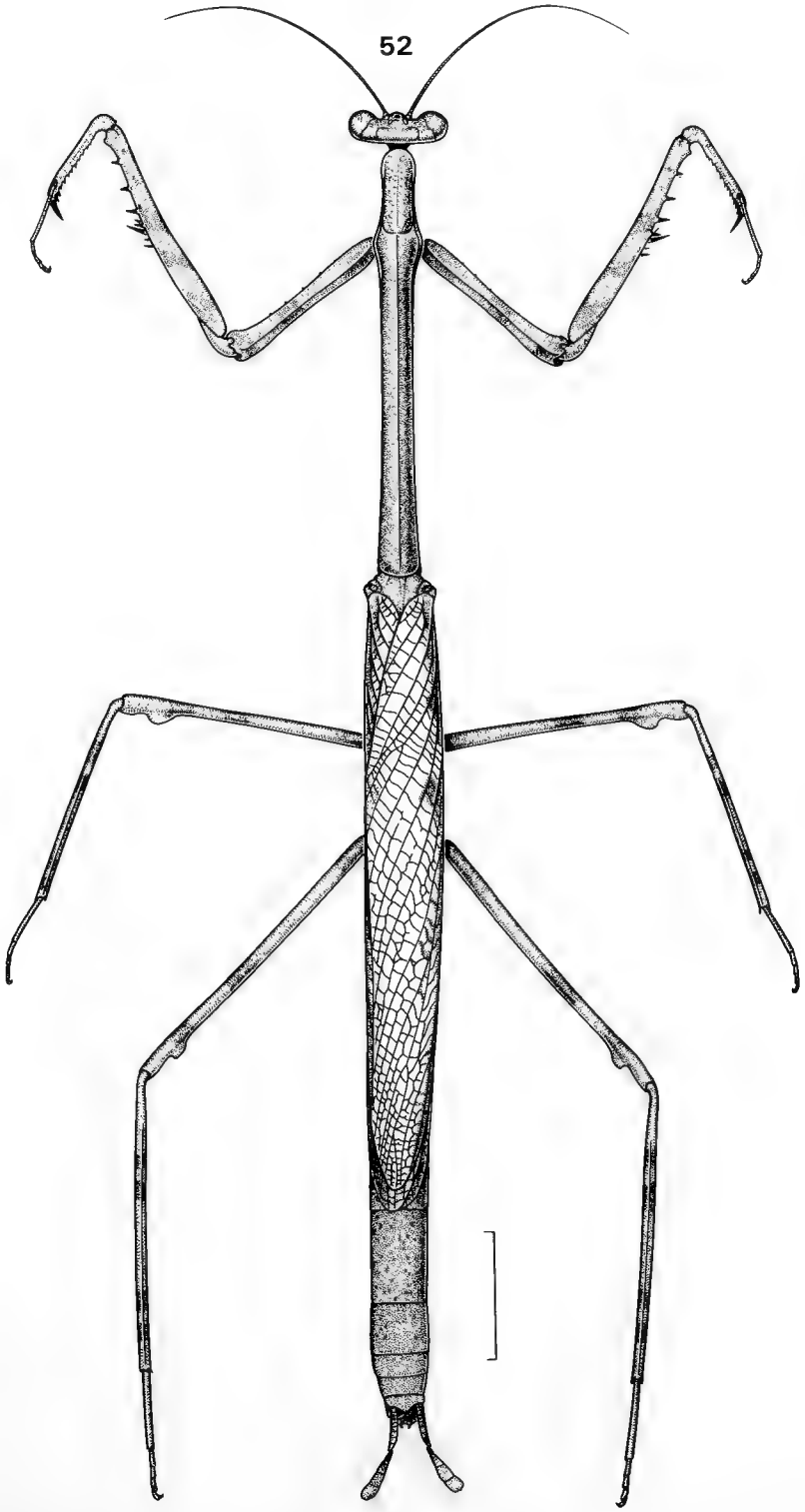


Figure 52. *Austrovates variegata*, male. Scale = 10 mm.

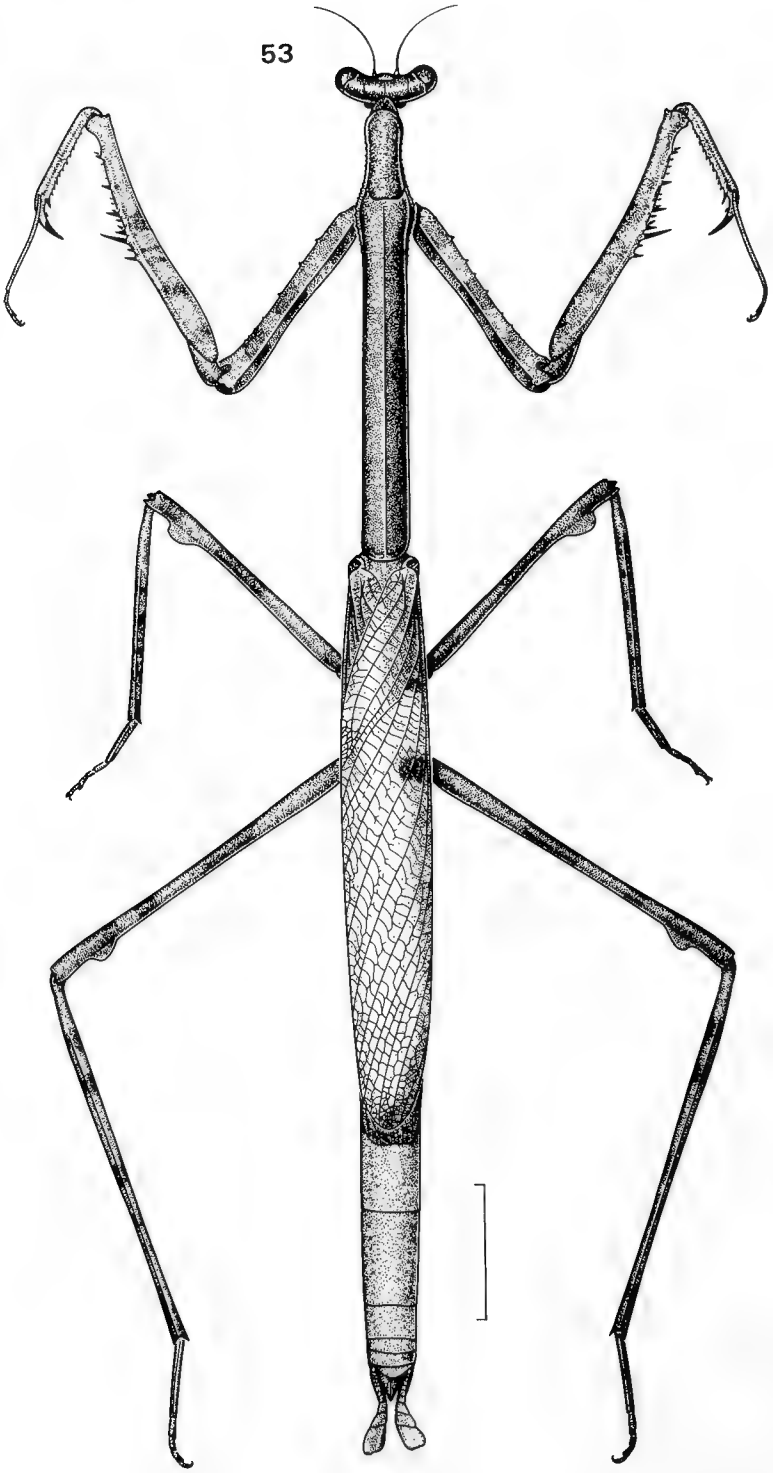


Figure 53, *Austrovates variegata*, female. Scale = 10 mm

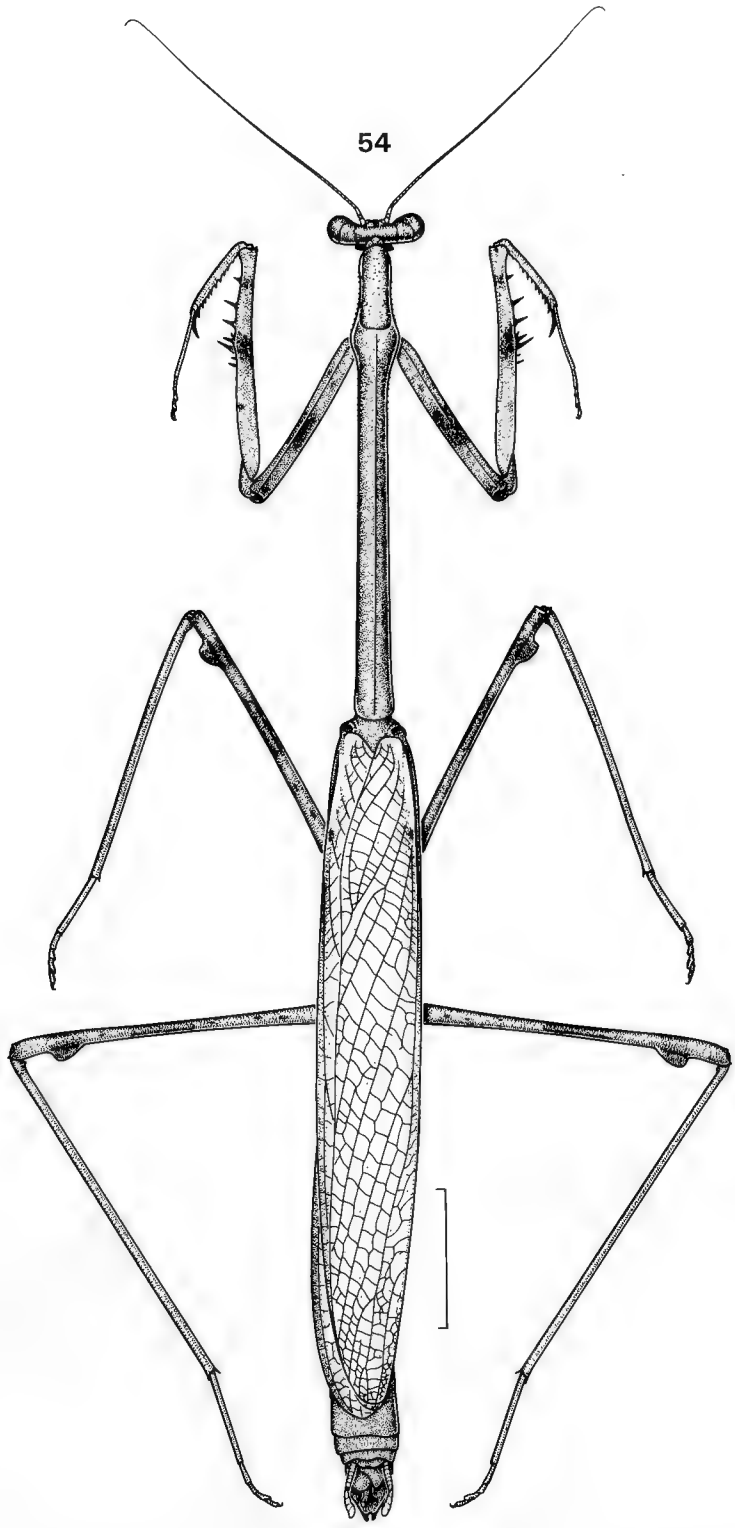


Figure 54, *Austovates papua*, male. Scale = 10 mm.

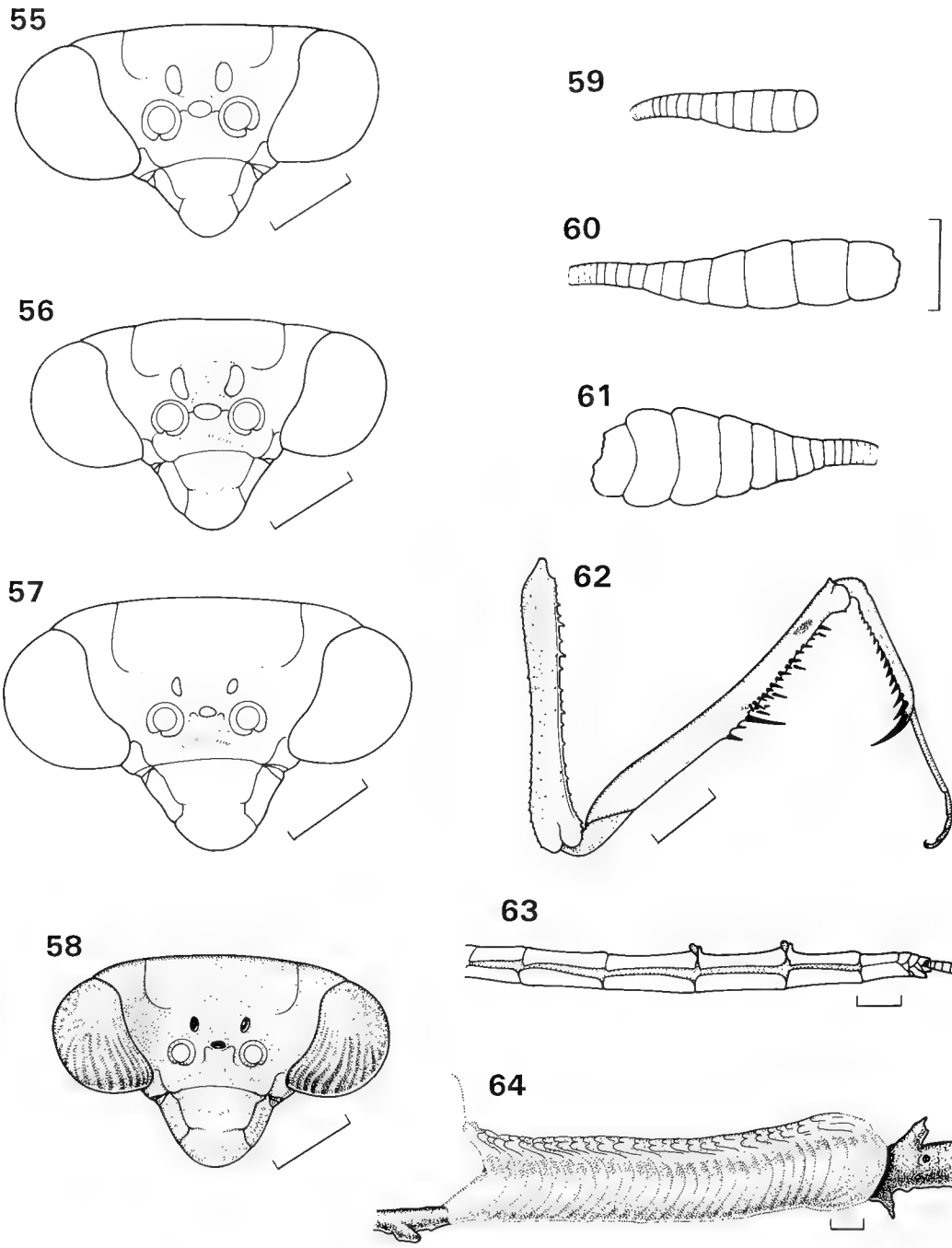
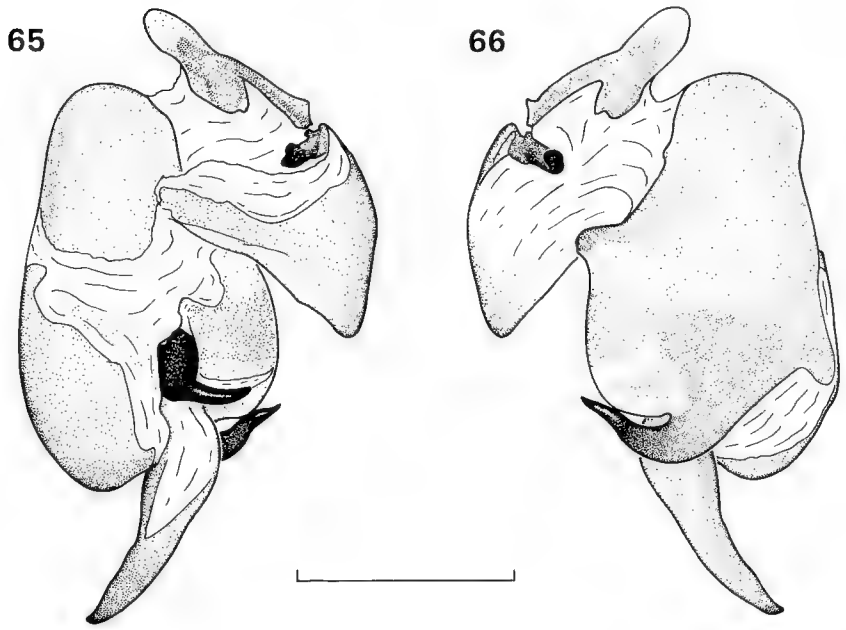
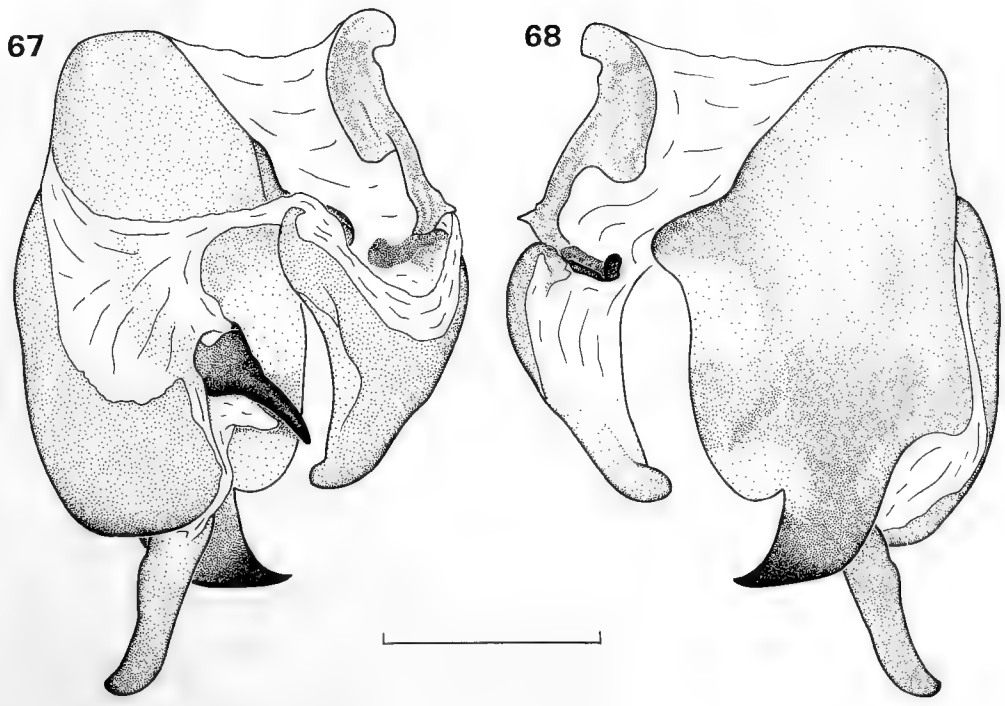


Figure 55, *Austrovates papua*, male head.
Figures 56–58, *A.variegata*. 56, male head; 57, female head; 58, female head, eye pattern.
Figure 59, *A.papua*, male cercus.
Figures 60–64, *A.variegata*. 60, male cercus; 61, female cercus; 62, female foreleg, inside; 63, mid instar nymph, lateral abdomen; 64, ootheca, dorso-lateral. Scale = 2 mm.





Figures 65–66. *Austrovates variegata*, male genitalia. 65, dorsal; 66, ventral.
Figures 67–68. *A.papua*, male genitalia. 67, dorsal; 68, ventral. Scale = 2 mm.

abdominal segment; cerci (fig. 59) quite short, distal segments broadened and laterally compressed, whitish in colour, apical segment with rounded margin. Genitalia (fig. 67–68) with dpr a rather broad short hook, pa smooth with single pointed projection directed posterio-laterally and slightly curved ventrally.

Measurements (mm). Body length, 95. Head width, 7.7. Head depth, 4.3. Pronotum length, 35.4. Pronotum width, 3.7. Fore coxa length, 15.2. Fore femur length, 17.4. Tegmen length, 49.5. Cercus length, 3.9.

Immature stages. Unknown.

Etymology. Specific epithet refers to the country in which the holotype was collected. It is a noun in apposition with feminine gender.

Distribution and habits. Known only from the holotype locality in southeastern Papua New Guinea (fig. 168). Habits are unknown but is likely to be a shrub dweller. The vegetation of the type locality is a mixture of grassland and woodland (Paijmans, 1975).

Archimantis Saussure

Archimantis Saussure, 1869: 56. Type species *Mantis latistylus* Serville, by monotypy.

Rheomantis Giglio-Tos, 1917: 44. Type species *Fischeria quinquelobata* Tepper, by monotypy.

Diagnosis. Body elongate, eyes with rounded to distinctly angular lateral margins, males macropterous, females brachypterous, mid and hind femora of adults without preapical lobes, cerci with distal segments broadened and laterally compressed.

Description. Body large, elongate, slender to rather robust. Head wider than high, anterio-posteriorly compressed, apical margin straight to slightly arched; frontal shield strongly transverse, usually with subantennal ridge; eyes with rounded to distinctly angular lateral margins; antennae as long or longer than pronotum in male, less than half the length of pronotum in female.

Prothorax long and slender with slight to pronounced supracoxal expansion; prozona smooth to lightly tuberculate above, strongly tuberculate beneath; metazona with more or less distinct median carina; pronotal margins smooth to strongly toothed.

Male macropterous but wings not entirely covering abdomen, female brachypterous; tegmen of male with costal area and costal margin of discoidal area opaque, remainder hyaline, tegmen of female similar to male or completely opaque, opaque areas strongly coloured beneath in both sexes; hindwing hyaline except for costal margin. Fore coxa shorter than metazone of

Key to the species of *Archimantis*

1.	Fore margin of anterior coxa with 3 to 5 mostly large teeth, black beneath	*A.quinquelobata*
—	Fore margin of anterior coxa without such teeth	2
2(1).	Lateral margins of pronotum strongly toothed	3
	Lateral margins of pronotum finely dentate or smooth	4
3(2).	Supracoxal expansion of pronotum broad (figs 102, 103)	*A. monstrosa*
—	Supracoxal expansion of pronotum narrow (figs 93, 94)	*A. armata*
4(2).	Lateral margin of eye distinctly angular, terminal segment of cercus distinctly pointed.	5
—	Terminal segment of cercus rounded or if pointed then eye margin rounded	6
5(4).	Cerci extremely elongate, pattern on inner face of fore coxa with large pale areas distally	*A. straminea*
—	Cerci moderately elongate, pattern on inner face of fore coxa dark distally	*A. brunneriana*
6(4).	Robust species, inner face of fore coxa pale proximally	7
—	Slender species, inner face of fore coxa dark proximally	8
7(6).	Tegmina of female short, covering only the first two abdominal terga, pa of male compact	*A. sobrina*
—	Tegmina of female medium, covering almost the first four abdominal terga, pa of male elongate spiniform	*A. latistyla*
8(6).	Tegmina of male distinctly banded	*A. vittata*
—	Tegmina of male not banded	*A. gracilis*

pronotum, anterior margin lightly to strongly armed; fore femur slender with 15 inner and four outer spines, 1st discoidal spine much longer than second, claw groove centrally situated; fore tibia with 8–11 outer spines and 13–17 inner spines; mid and hind legs long and slender, femora of adults without preapical lobes.

Abdomen elongate, slender and dorso-ventrally compressed, more so in male; anterior margins of abdominal sternites distinctly coloured; supraanal plate transverse, cerci slightly to distinctly elongate with distal segments strongly laterally compressed. Vph of male genitalia with medial lobe prominent and more or less curved dorsally; dpr more or less produced into single, strongly sclerotised hook curving dextrad; lph with apr curved sinstrad with rounded tip; pa separated from vl of lph by membraneous area; ml elongate and finely hirsute; rph with medial arm partially sclerotised, aa elongate but squamiform sinstrad; vpl continuous with main body of rph; vspr small, heavily sclerotised and more or less u-shaped.

Archimantis latistyla (Serville)

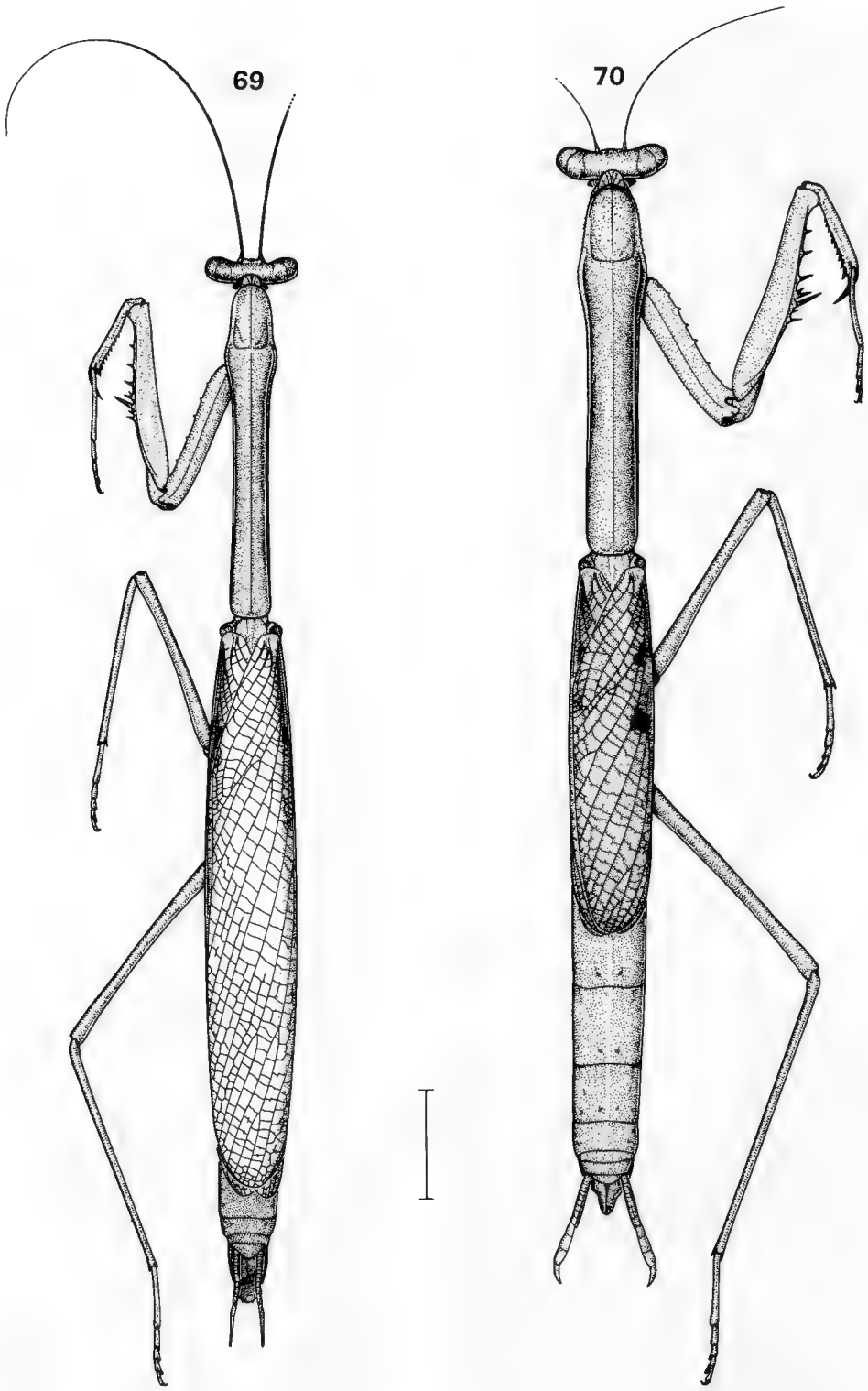
Figures 69–80, 170

Mantis latistylus Serville, 1838: 179
Archimantis latistylus (Serville).-Saussure, 1869: 65
Archimantis latistyla (Serville).-Giglio-Tos, 1912: 164
Mantis fuscielytris McCoy, 1886: 118.
Archimantis latistylus gigantea Beier, 1963: 9. Syn. nov.

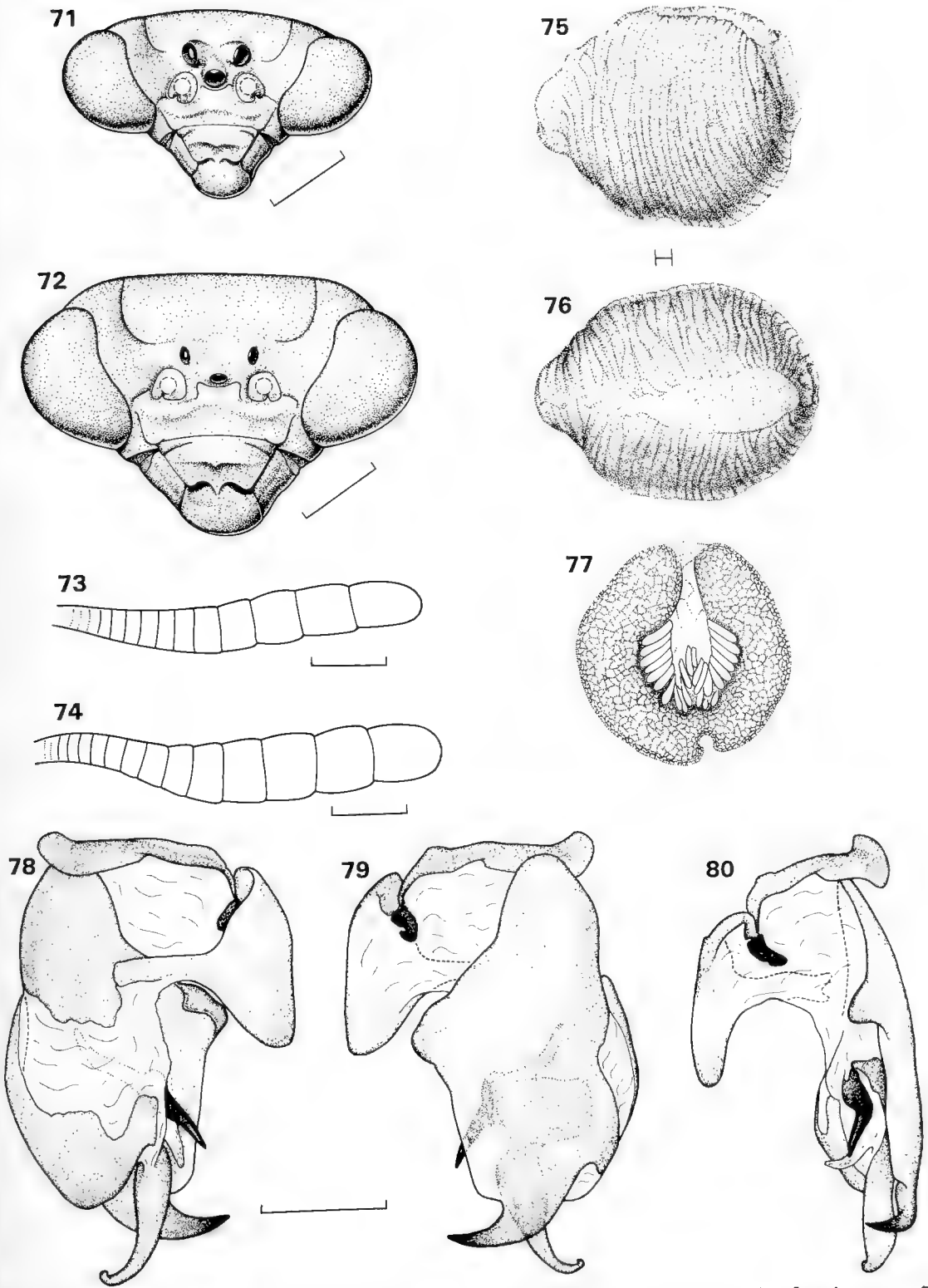
Material examined. Two syntype females of *Mantis fuscielytris*, Victoria (both NMV). Holotype female of *Archimantis latistylus gigantea*, Rockhampton (Qld), ex Museum Godeffroy, 2677 0.273 (ZMH).

Other specimens examined (104♂, 159♀, 110 juv.). ACT. 1 juv., Black Mt, 30 Dec 1929. ♀, Black Mt, 15 Dec 1964. ♂, Black Mt, 13 Jan 1965. ♂, Black Mt, 22 Dec 1964. ♂, Black Mt, 10 Jan 1966. ♂, Black Mt, 23 Dec 1969. 1m, Black Mt, 22 Jan 1967. ♂, Black Mt, 24 Dec 1965. ♂, Black Mt, 23 Jan 1964. ♂, Black Mt, 16 Dec 1982. 2♂, Black Mt, Jan 1969. 6♂, ♀, Black Mt, Dec 1961. ♂, Black Mt, Oct 1961. ♂, Black Mt, Jan 1969. 3♂, Black Mt, Jan 1963. ♂, Black Mt, Dec 1963. ♀, Canberra, 15 Jan 1978. ♀, Canberra, 21 Jan 1962. ♀, Canberra, 19 Jan 1987. ♀, 35°18′S, 148°58′E, 1 km E of Mt McDonald, 11 Dec 1980. ♂, 35°22′S, 148°57′E, Murrays Corner, Paddys River, nr Canberra, 29 Dec 1985. ♀, Uriarra, 28 Jan 1984 (all ANIC). ♀, Black Mt Reserve, Canberra, 26 Jan 1982 (NMV).

Qld. ♂, Cathu State Forest, N of Eungella Nat Pk, 21 Jan 1990. ♀, Clermont, 7 Feb 1981. ♀, Clermont, Jan 1929. 2♂, Coominglah Range, 24 km N of Monto, 6 Jan 1975. 4♂, 8 km E of Emuford, 30 Dec 1989. 2♂, Forty Mile Scrub, 65 km W of Mt Garnet, 19 Dec 1974. ♀, Millstream Falls, nr Ravenshoe, 5 Jan 1967. ♀, Mount Tamborine, Dec 1925 (all AM). ♂, ♀, 2 juv., 20 km W of Arcadia HS, 24 Oct 1967. ♂, 2♀, 1 juv., 2526′S, 15123′E, Binjour Plateau, 31 km N of Gayndah, 19 Apr 1982. ♀, Bluff Range, nr Biggenden, 2–12 May 1971. ♂, Bodumba Creek, nr Kenilworth, 12 Jan 1986. 2♂, 3♀, 11 juv., 22°31′S, 148°43′E, 9 km ESE of Bombandy HS, 24 Apr 1981. ♂, Bribie I., 18–26 Dec 1972. ♀, 28°02′S, 153°26′E, Broadbeach, 28 Dec 1970. 1 juv., 20 km NE of Bundaberg, Apr 1971. 2 juv.., Bundaberg, Apr 1971. 1 juv., Bundaberg, Mar 1971. 2♀, 1 juv., Bundaberg, May 1971. 1 juv., 3 km N of Bundaberg, 19–21 Apr 1971. ♂, ♀, 4 juv., 26°00′S, 153°05′E, Camp Milo, Cooloola Nat Pk, 16 Apr 1982. ♀, Castle Hill, Townsville, 3 Apr 1962. ♂, Ceratodus, 31 Dec 1955. ♂, 8 km S of Clermont, 18 Mar 1982. 1 juv., 13°56′S, 143°12′E, Coen, 18 Jul 1986. ♂, 18°35′S, 144°44′E, 12 km N of Conjuboy HS, 12 Nov 1981. ♂, Cunninghams Gap, MacPherson Range, 3–4 Dec 1982. ♀, 25°21′S, 151°13′E, 9 km NE of Eidsvold, 20 Apr 1982. ♀, 18°03′S, 144°52′E, Forty Mile Scrub Nat Pk, 52 km SSW of Mt Garnet, 22 Jul 1986. ♀, Gordonvale, 19 Jan 1962. ♂, ♀, 11°41′S, 142°28′E, 3 km NE of Gunshot Creek, 17 Mar 1992. ♂, 11°49′S, 142°30′E, 6–10 km SSE of Heathlands HS, 14 Mar 1992. 2♀, 11°49′S, 142°30′E, 6–10 km SSE of Heathlands HS, 28 Mar 1992. ♂, 11°45′S, 142°35′E, Heathlands HS, 10 Mar 1992. ♀, 11°46′S, 142°41′E, 11 km E of Heathlands HS, 11 Mar 1992. ♂, 17 km NNW of Hivesville, 3 Jan 1965. 1 juv., 1514′S, 14507′E, 7 km N of Hope Vale Mission, 4 Oct 1980. ♂, ♀, 4 juv., 23°46′S, 149°06′E, 2 km S of Horshoe Lookout, Blackdown Tableland, SW of Dingo, 1–2 Feb 1981. 1 juv., 18°27′S, 146°08′E, 22 km N of Ingham, 28 Sep 1979. ♂, Innot Hot Springs, 11 Jan 1962. ♂, 17°25′S, 145°04′E, 15 km W of Irvinebank, 27–28 Nov 1981. 3 juv., 18 km SW of Lake Nuga Nuga, Carnarvon Range, 25 Oct 1967. ♂, 150 km N of Marlborough, 9 May 1955. ♀, 28°04′S, 153°27′E, Miami, 31 Dec 1970. 2♀, 2 juv., 27°51′S, 150°21′E, 15 km S of Moonie, 22 Apr 1982. 2♂, 3♀, 7 juv., 15°10′S, 145°07′E, 3.5 km SSW of Mt Baird, nr Cooktown, 3–5 May 1982. ♀, Mt Cook Nat Pk, 11 Oct 1980. ♀, 26°54′S, 152°54′E, Mt Coonowrin, Glasshouse Mts, 9 Aug 1985. 3 juv., 26°54′S, 152°38′E, Mt Ngungun, Glasshouse Mts, 9 Aug 1985. ♂, 2♀, 4 juv., 25°26′S, 152°56′E, Mt Tibrogargan, Glasshouse Mts, 15 Aug 1985. ♀, 6 juv., 12°44′S, 143°13′E, 2 km NNE of Mt Tozer, Iron Range Nat Pk, 3 Jul 1986. 7 juv., 12°42′S, 143°20′E, 13 km ENE of Mt Tozer, nr Iron Range Nat Pk, 10 Jul 1986. 2♂, ♀, 15°03′S, 145°09′E, 3 km NE of Mt Webb, nr Cooktown, 30 Apr-3 May 1981. 3 juv., 1503′S, 145°09′E, 3 km NE of Mt Webb, 2 Oct 1980. ♀, 12 km W of Moura, nr Banana, 30 Dec 1955. ♂, 23°41′S, 149°51′E, Mourangee Stn, NW of Edungalba, nr Duaringa, 2 Jul 1980. 2 juv., 3 km SE of Planet Downs HS, E of Rolleston, 25 Oct 1967. 1 juv., 17°38′S, 145°26′E, 7 km WSW of Ravenshoe, 12 Nov 1981. ♂, 23°43′S, 150°42′E, 50 km S of Rockhampton, 13 Dec 1968. 3 juv., 18 km N of Roma, 24 Oct 1967. ♂, ♀, 15°17′S, 145°13′E, 1 km N of Rounded Hill, nr Cooktown, 5–7 May 1981. 2♂, ♀, 15°17′S, 145°14′E, 3 km ENE of Rounded Hill, nr Cooktown, 5–7 May



Figures 69–70, *Archimantis latistyla*. 69, male; 70, female. Scale = 10 mm.



Figures 71–80, *Archimantis latistyla*. 71, male head; 72, female head; 73, male cercus; 74, female cercus; 75, ootheca, lateral; 76, ootheca, dorsal; 77, ootheca, transverse; 78, male genitalia, dorsal; 79, male genitalia, ventral; 80, male genitalia, right lateral. Scale = 2 mm.

1981. 1 juv., 15 km NE of St.George, 8 Nov 1974. ♀, Stanthorpe, 11 Jan 1982. ♀, Taroom, 3 Jul 1974. ♂, 28°56′S, 151°08′E, 9 km SSW of Texas, 24 Nov 1983. ♀, 1 juv., 25°46′S, 152°38′E, 8 km SE of Tiaro, 14 Aug 1985. 2 juv., Watalgan Range, nr Bundaberg, 6 Nov 1971. 1 juv., 130°6′S, 142°56′E, Wenlock River Crossing, Portland Roads Rd, 30 June 1986. ♂, ♀, 26°07′S, 152°47′E, Wilsons Pocket, 14 km ENE of Gympie, 18 Apr 1982 (all ANIC). ♀, 15°19′S, 145°01′E, 2.5 km S of Bald Hills Stn, 4 Apr 1991. ♂, Brisbane, 3 Dec 1965. ♀, Bowen. 1 juv., Bruce Hwy, 4 km S of Bowen, 1 Apr 1991. ♂, 140 km S of Charters Towers, 19 Feb 1989. ♂, Chillagoe, 27 Mar 1989. ♀, 17°13′S, 145°47′E, 5.5 km N of Collins Weir, W of Atherton, 10 Apr 1991. ♀, 17°15′S, 145°17′E, 1 km NNE of Collins Weir, W of Atherton, 10 Feb 1989. ♀, Cooktown, Jul 1970. ♂, Cooktown, 7 Apr 1991. ♂, Cooktown, 8 Apr 1991. ♂, 16°59′S, 145°33′E, Davies Creek Rd, 2 km E of Kennedy Hwy, 8 Feb 1989. ♂, 16°43′S, 145°38′E, Ellis Beach, 28 Nov, 1983. ♀, Forty Mile Scrub Nat Pk, 22 Feb 1989. ♀, Georgetown, 15 Apr 1991. 1 juv., 15°32′S, 145°12′E, Hardwicke Creek, 0.5 km S of Annan River, 6 Apr 1991. ♀, Hodzoic Rd, 0.7 km E of Peninsular Development Rd, N of Mareeba, 15 Feb 1989. 2♂, Julago, 13 km SE of Townsville, 3 Feb 1989. ♀, 1843′S, 14438′E, Kennedy Development Rd, Spring Creek HS turnoff, 17 Apr 1991. 2♀, Mt Molloy, 10 Mar 19°90. 2♀, 10 km S of Mt Ossa, 3 Feb 1989. ♂, 15°31′S, 145°08′E, Oaky Creek Rd, 15 km SW of Cooktown, 9 Apr 1991 (all NMV). ♂, Brisbane, 25 Jan 1916. ♂, Brisbane, 22 Dec 1917. ♂, Brisbane, 13 Oct 1914. ♀, Brisbane, 14 Mar 1918. ♀, Brisbane, 22 Oct 1917. ♀, Emerald. ♀, Moreton Island, Apr 1916. ♀, Stanthorpe, 30 Jan 1941. 2♀, Stradbroke Island, 5 Dec 1913. (all QM). ♂, Cairns. ♀, Endeavour River, Cooktown. 3♀, Maryborough. ♂, Somerset. ♂, Stanthorpe (all SAM). ♂, Biloela, 11 Feb 1947. ♀, Brisbane, 3 Nov 1952. ♂, Brisbane, 1 Apr 1961. ♀, Brisbane, 16 Sep 1962. ♂, Brymaroo, 30 Jan 1948. ♀, Mackay, 3 Feb 1934. ♂, Murarrie, 4 Jun 1964. ♀, Nambour, Jan 1962. ♀, Yuleba, Jan 1964 (all UQ).

New South Wales. 2♀, Beacon Hill, nr Sydney, 7 Dec 1978. ♀, Clark Island, 22 Jan 1930. 1 juv., Dobroyd Head, Sydney Harbour, 14 Feb 1978. ♂, Eccleston, 15 Dec 1922. ♂, French's Forest, Sydney, 7 Nov 1922. ♂, Hornsby, Mar 1911. ♀, Jannali, 26 Nov 1933. 1 juv., Kurnell, 3 May 1931. ♂, Matraville, Nov 1925. 1 juv., North Head, Sydney, 14 Feb 1978. ♀, St.Ives, nr Sydney, Dec 1967. 2♂, Sydney. ♀, Vaucluse, Sydney, Apr 1927. ♀, Wallaby Creek, Tooloorn, 5–13 Dec 1962. ♀, Willoughby, Dec 1922. ♂, Woronora River, Engadine, 16 Dec 1976 (all AM). ♂, Bankstown, Sydney, Oct 1964. ♀, 33°03′S, 151°40′E, Belmont Golf Club, nr Newcastle, 19 Nov 1982. 2 juv., 34°44′S, 147°54′E, 5 km NE of Bethungra, 13 Sep 1968. ♀, Bomaderry, 25 Dec 1967. 1 juv., Bonville, 25 Aug 1977. ♂, 6 km W of Bonville, 12 Dec 1969. ♂, Broulee, 9 Jan 1962. ♀, 33°08′S, 151°38′E, 3 km NNE of Catherine Hill Bay, nr Newcastle, 19 Nov 1982. ♀, Cheltenham, 12 Mar 1967. ♂, 35°58′S, 150°09′E, Congo, 8 km ESE of Moruya, 17 Dec 1983. 1 juv., 3501′S, 15049′E, Currarong, 17 Aug 1977. 2 juv., Enmore Falls, 19 Mar 1961. 1 juv., 29°06′S, 153°24′E, 3.7 km NW of Evans Head, 14 Dec 1971. ♀, 29°07′S, 153°25′E, 2.3 km WNW of Evans Head, 14 Dec 1971. ♀, 5 km N of Evans Head, 13 Dec 1955. ♂, 2♀, 1 juv., 28°24′S, 152°53′E, Findon Creek, 27 km E of Woodenbong, 20 Nov 1983. ♀, Forster, 2 Feb 1967. 1 juv., Forster, 11 Dec 1947. ♂, 33°12′S, 151°36′E, Geebung Camp, Lake Munmorah, 15 Nov 1983. 1 juv., 32°53′S, 151°32′E, Great Sugarloaf Mountain, nr West Wallsend, 16 Nov 1983. ♀, 3502′S, 15035′E, Huskisson, 26 Sep 1984. ♀, Killarney Heights, 11 Oct 1969. ♀, Kincumber, Dec 1949. 2♀, Kogarah, May 1925. 1 juv., Korora Bay, nr Coffs Harbour, 22 May 1966. ♂, 28°35′S, 153°08′E, 13 km ENE of Kyogle, 20 Nov 1983. ♀, Lake George, 29 Jan 1972. ♀, Lake George, 2 Feb 1972. ♀, 6 juv.., Lake George, 1974. 3 juv., Lake George, 1971. 1 juv., Lawrence, 22 Jun 1985. 1 juv., Lindfield, 23 Apr 1927. ♀, 4 km S of Mogriguy, 1 Jan 1971. ♂, 34°46′S, 150°37′E, Mt Tapitales, 7 km NW of Berry, 30 Dec 1975. ♀, Mt Wilson, 11 Jan 1929. ♀, 8 km S of Murwillumbah, 31 Jan 1963. ♀, Narrabeen, 28 Sep 1951. 2♀, Nelligen, 4 Dec 1950. ♀, 35°36′S, 150°04′E, 8 km NW of Nelligen, 15 Feb 1984. 1 juv., 1.5 km SSW of Nerriga, 14 Nov 1962. 1 juv., Northbridge, 26 Oct 1927. ♂, Northbridge, Nov 1928. ♀, Point Perpendicular, Jervis Bay, 27 Dec 1966. ♀, 31°26′S, 152°56′E, Port Macquarie, 31 Dec 1968. ♀, Queanbeyan, Feb 1985. ♂, Sans Souci, Georges River, 19 Jan 1955. 2♀, South Turramurra, 26 Mar 1967. ♂, ♀, 1.5 km SE of Southwest Rocks, NE of Kempsey, 3 Jan 1970. 1 juv., Sydney, 28 May 1951. ♂, Teachers College, Wagga, 1968. ♀, 2 km NNW of Teagardens, Port Stephens, 15 Jan 1971. ♀, Tea Tree Creek, Armidale, 7 Jan 1960. ♀, 28°58′S, 151°43′E, 31 km WNW of Tenterfield, 23 Nov 1983. ♂, 3 km S of Tooraweenah, 6 Jan 1956. 1 juv., 3 km S of Ulladulla, 15 Oct 1966 (all ANIC). ♂, 25 km ENE of Goulburn, 30 Dec 1990 (NMV). ♀, Sydney (SAM).

Vic. 2♀, Rosebud, Mornington Penninsula, 16 Jan 1970. ♀, 37°59′S, 147°43′E, Rotamah Island, 20 km SSE of Bairnsdale, 30 Nov-1 Dec 1984. ♀, 20 km ENE of Stratford, 2 Dec 1956. 1 juv., 39°01′S, 146°18′E, Tidal River, Wilsons Promintory, 5–6 Nov 1985 (all ANIC). 1 juv., Balwyn, 27 Aug 1908. ♀, Bullbeef Creek, 2 km W of Mt Tanjil, 19 Apr 1982. ♂, 34°43′S, 142°26′E, Chalka Creek, Hattah Lakes Nat Pk, 21 Jan 1987. ♀, Croydon, 4 Dec 1904. 1 juv., Fernshaw. 2♂, 2 juv., Frankston. ♀, Gippsland. ♀, Kow Plains, Dec 1910. ♀, Launching Place, 9 Nov 1983. ♂, ♀, Mooroolbark, Mar 1977. ♀, Murrayville Track, 13 km S of Murrayville, 26 Feb 1987. 3♀, 35°25′S, 141°10′E, 16.8 km SSW of Murrayville, 18 Feb 1987. ♀, Rhyll, Phillip Island, 8 Mar 1948. 2 juv., Rotamah Island, Gippsland Lakes, 9 Mar 1986. ♀, Trafalgar, Gippsland, 9 Dec 1892. ♀, 35°32′S, 142°32′E, Waithe Fauna Reserve, 24 Jan 1986. ♂, ♀, 35°32′S, 142°25′E, Waithe Fauna Reserve, 21 Jan 1987. ♂, 35°32′S, 142°29′E, Waithe Fauna Reserve, Feb 1987 (all NMV). 2♂, Healesville district. 1 juv., Healesville, 20 Oct 1910. ♀, Mt Yule, Healesville, 14 Nov 1911 (all QM).

SA. 1 juv., 33°53′S, 136°36′E, 5 km NE of Arno Bay, 21 Oct 1982. ♂, 34°08′S, 135°22′E, 3 km SSE of Mt Hope, 20 Oct 1982. 1 juv., 8 km SSE of Mt Hope, 29

Oct 1969. ♂, ♀, 1 juv., 35°59′S, 137°11′E, Vivonne Bay, Kangaroo Island, 8 Dec 1977 (all ANIC). ♀, Adelaide, 3 Jan 1887. ♂, Kangaroo Island. ♀, Lucindale, 29 Jan 1892. ♂, Murat Bay. ♂, Murray River. ♀, Peake, 23 Mar 1909. ♂, Scorpion Springs Conservation Pk, 5 km SW of Nanams Well, 17 Dec 1983 (all SAM). Western Australia. ♂, 29°35′S, 115°09′E, 27 km NNW of Eneabba, 24 Oct 1984. ♂, 33°18′S, 123°22′E, 18 km NNW of Mt Ragged, 12 Nov 1969 (both ANIC).

Diagnosis. Eyes with lateral margins rounded, margins of pronotum without distinct teeth, anterior margin of fore coxa without large teeth, inner face of fore coxa pale proximally, tegmina of female covering first 3–4 abdominal segments, apical segment of cercus with rounded margin, pa of male genitalia produced into single spine.

Description. Body rather robust, brown, greyish brown or greenish brown. Apical margin of head broadly arched, eyes slightly protuberent anteriorly with rounded lateral margins, frontal shield with distinct subantennal ridge. Prothorax moderately to very elongate, slight but distinct supracoxal expansion, lateral margins smooth except in prozona of female where they are finely tuberculate, metazona smooth dorsally with distinct mid dorsal keel, prozona with few small scattered tubercles dorsally but with denser and more pronounced tubercles beneath. Fore coxa with 5 small sharply pointed teeth on anterior edge, females often with few smaller ones between, inner face not distinctly patterned. Fore femur with all spines blackish. Fore tibia with 14–15 inner and 8–11 outer spines, all tipped blackish brown. Mid and hind femora sometimes with genicular spine. Wings of male covering first seven abdominal segments; tegmen hyaline except for costal area and costal margin of discoidal area which are opaque brown above, costal area beneath glossy black in proximal fifth with remainder whitish with black cross veins, costal margin of discoidal area intense orange-brown beneath; discoidal area usually with dark spot at proximal and distal end of stigma though distal spot sometimes absent, venation slightly to distinctly darkly pigmented. Wings of female just surpassing caudal margin of third abdominal segment to just short of caudal margin of fourth; tegmen similar in colour to that of male except discoidal area completely opaque. Hindwings of both sexes with costal area orange-brown, remainder hyaline with veins slightly to distinctly pigmented particularly toward apex.

Abdomen without distinct white mid dorsal stripe, anterior margin of sternites 3–5 coloured black and red but only visible when abdomen flexed. Cerci (fig. 73–74) as long as to about twice as long as subgenital plate, apical segment with margin rounded. Male genitalia (figs 78–80) with dpr of vph strongly curved, broad at base, narrow toward tip; anterior portion of vl of lph broadly rectangular, slightly produced at junction with pa; apr swollen medially, tip slightly mucronate; pa produced into single spine directed laterally to posterio-laterally, surface finely shagreened except at tip.

Measurements (mm). Body length, ♂ 78–97, ♀ 87–127. Head width, ♂ 7.8–8.8, ♀ 9.0–11.6. Head depth, ♂ 4.6–7.4, ♀ 6.0–9.6. Pronotum width, ♂ 3.8–4.6, ♀ 5.4–7.2. Pronotum length, ♂ 25–32, ♀ 28–45. Fore coxa length, ♂ 12–16, ♀ 16–21. Fore femur length, ♂ 14–18, ♀ 18–24. Tegmen length, ♂ 48–53, ♀ 32–42. Cercus length, ♂ 6.4–9.8, ♀ 8.0–9.0.

Immature stages. Nymphs have a broken white mid dorsal abdominal stripe and are often more mottled in colour than adults. There is also a green colour variant in nymphs however this appears to become brownish in the final instar. The ootheca (figs 75–77) is large and globular with a thick spongy outer layer, eggs arranged in a w-shaped formation and is pale brown or green in colour. It is deposited on the stems of shrubs and tall grasses, and is often parasitised by wasps of the genus *Podagrion*.

Distribution and habits. Known from eastern Australia, essentially along the Great Dividing Range, from Cape York south through Victoria to the south eastern corner of South Australia (fig. 170). There are also two doubtful records from Western Australia. Predominantly a shrub dweller although nymphs may sometimes be found in grasses. Adults are most commonly encountered from December to April. The distinctive colours on the ventral costal margins of the wings and on the anterior margins of the abdominal sternites are seen during the defensive display.

Remarks. Serville's syntypes of this species cannot be located (Balderson, 1984). This is a widely distributed and somewhat variable species. Specimens become progressively larger and the prothorax more elongate toward the north. The cerci also become reduced in size at the northern end of the range. Beier's *A.l.gigantea* falls within this range of variation.

Archimantis sobrina Saussure

Figures 81–92, 174

Archimantis sobrina Saussure, 1873: 26.
Archimantis minor Giglio-Tos, 1917: 43. Syn. nov.

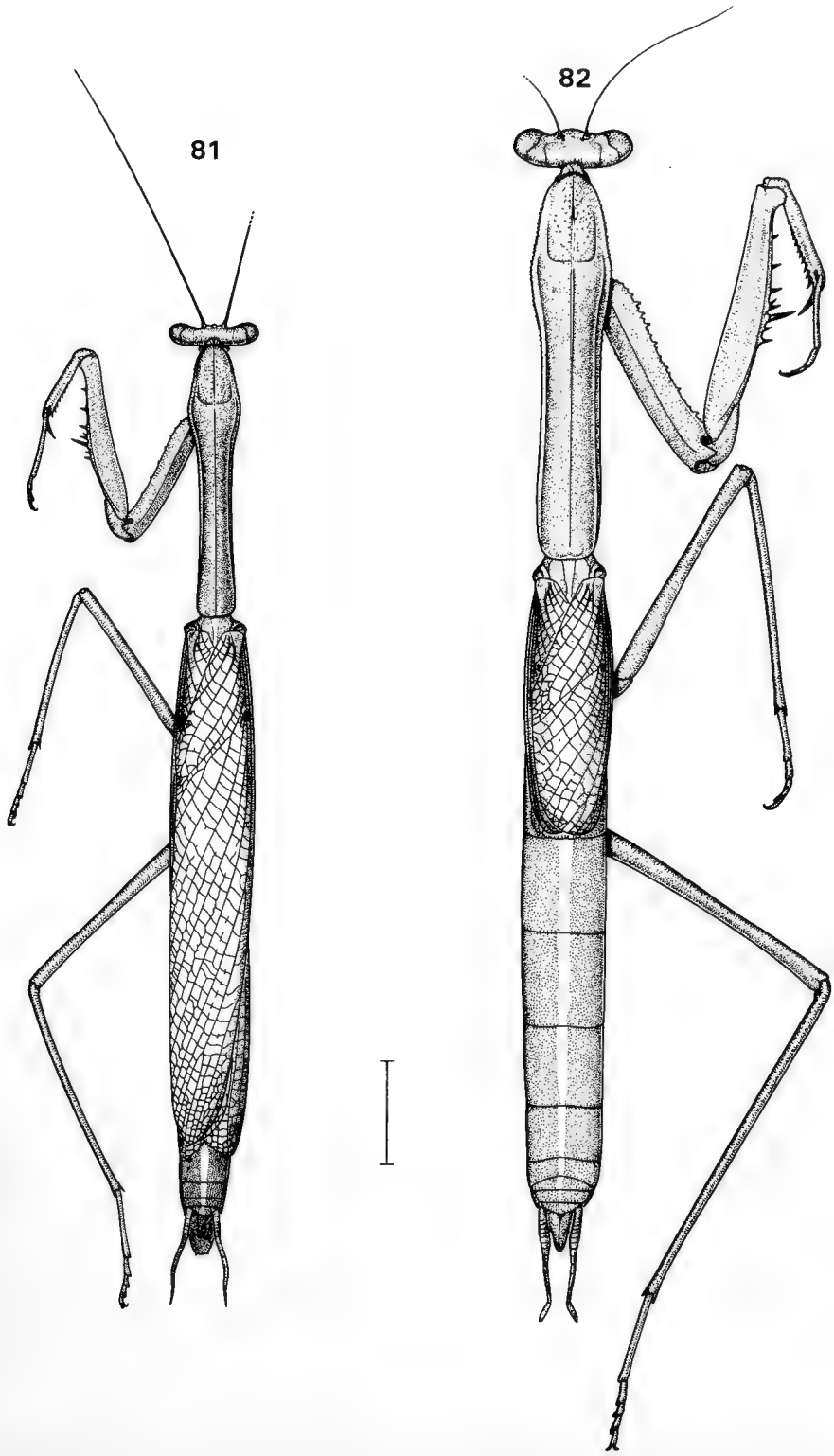
Material examined. Syntype female of *Archimantis minor*, King George's Sound (Western Australia), Captain Grey, 40 12–16 17b. Syntype female of *Archimantis minor*, Swan River (Western Australia), 43 14 (both BMNH).

Other specimens examined (252♂, 150♀, 94 juv.). ACT. 3♂, Black Mt, 29 Dec 1965. ♂, Black Mt, 16 Jan 1961. 3♂, Black Mt, 22 Dec 1964. ♂, Black Mt, 25 Jan 1965. 14♂, Black Mt, 29 Dec 1961. 3♂, Black Mt, 3 Jan 1962. 2♂, Black Mt, 4 Jan 1962. 4♂, Black Mt, 24 Dec 1962. ♂, Black Mt, 14 Jan 1963. 3♂, Black Mt, 2 Jan 1963. ♂, Black Mt, 5 Jan 1962. 3♂, Black Mt, 15 Jan 1962. ♂, Black Mt, 26–28 Jan 1963. ♂, Black Mt, 29 Jan 1963. ♂, Black Mt, 20 Jan 1950. 2♀, Black Mt, 13 Jan 1950. ♂, Black Mt, 30 Dec 1951. ♂, Black Mt, 1 Jan 1950. 2♂, Black Mt, 5 Jan 1952. ♂, Black Mt, 20 Jan 1953. 2♂, Black Mt, 26 Dec 1961. ♂, Black Mt, 4 Jan 1952. 2♂, Black Mt, 22 Dec 1952. ♂, Black mt, 19 Jan 1953. ♂, Black Mt, 24 Dec 1952. ♂, Black Mt, 31 Jan 1968. 3♂, Black Mt, 12 Dec 1967. 3♂, Black Mt, 21 Dec 1969. ♂, Canberra, 18 Dec 1959. ♂, Canberra, 12 Jan 1965. ♂, Canberra, 6 Jan 1964. ♂, Canberra, 30 Dec 1950. ♂, Canberra, 5 Dec 1961. 2♂, Canberra, 20 Dec 1950. 2♂, Canberra, Dec 1949. ♂, Canberra, 26 Dec 1978. ♀, Canberra, 1 Jan 1950. ♀, Canberra, 4 Mar 1966. 2♂, Canberra, 11 Jan 1972. 1 juv., Canberra, 1 May 1983. ♂, Cotter Dam, Dec 1930. ♀, Pierces Creek, 21 Jan 1950. ♀, 8 km NNE of Tharwa, 17 Dec 1956 (all ANIC).

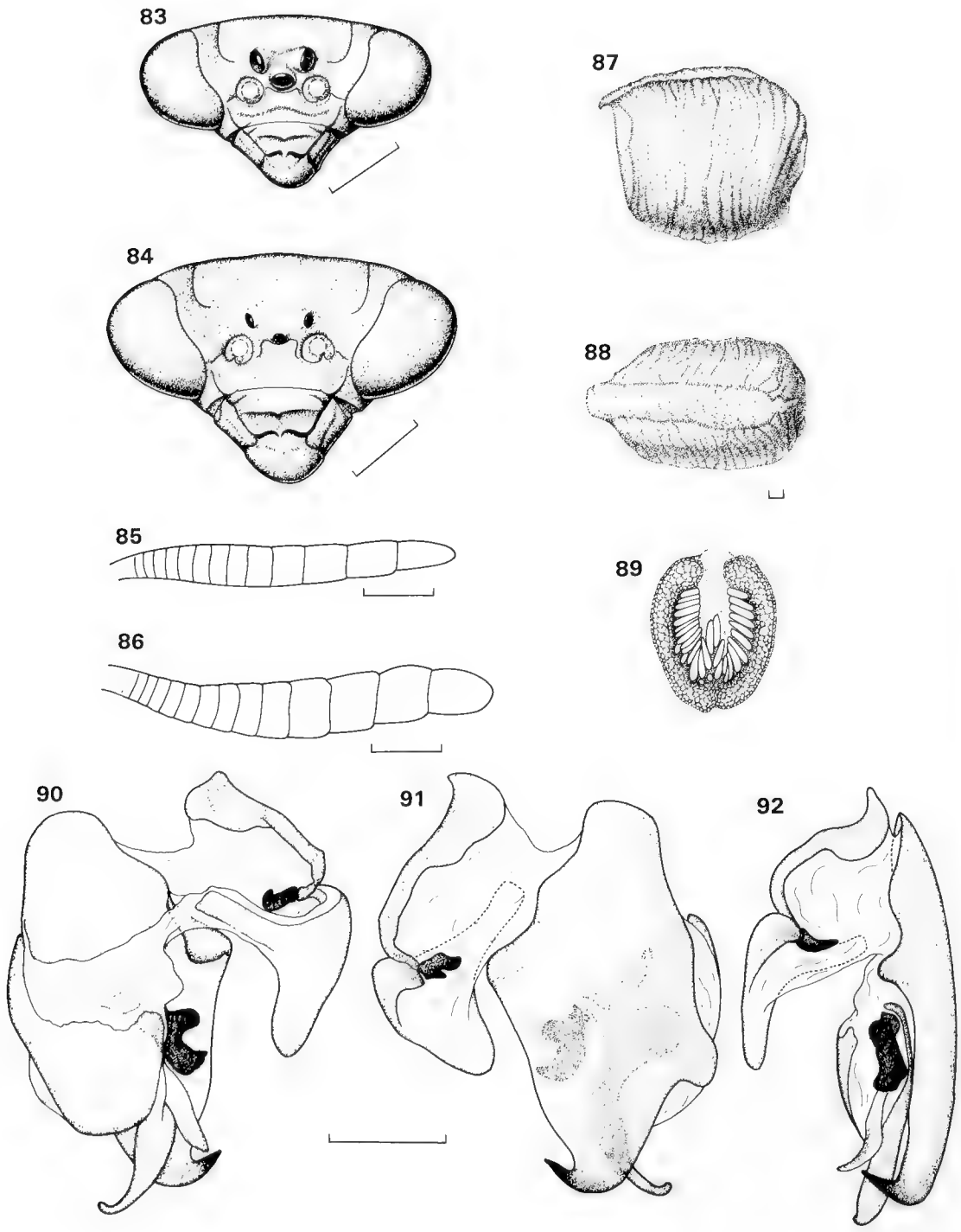
Qld. ♀, Hughenden, 21 Mar 1930. ♂, Windorah, 5 Nov 1963 (both AM). 3♂, 4 km SW of Birdsville, 4 Dec 1974. ♂, Blackall, 10 Apr 1972. 1 juv., 48 km N of Blackall, 27 Dec 1961. ♂, 23°02′S, 139°18′E, 62 km SW of Boulia, 16 Oct 1978. ♂, 7 km N of Cunnamulla, 29 Jan 1971. 2 juv., 23 km W of Cunnamulla, 13 Jan 1965. ♂, Gilruth Plains Stn, E of Cunnamulla, 8 Jan 1964. ♂, Longreach, 20–31 Jan 1972. ♂, 2141′S, 14030′E, Selwyn Mine, 160 km SE of Mt Isa, 7 Oct 1991. ♂, St George, 19 Jan 1969. 1 juv., 50 km NNE of Wyandra, 25 Dec 1961. ♀, 20°18′S, 139°03′E, 20 km ESE of Yelvertoft HS, nr Camooweal, 9 Apr 1976 (all ANIC). ♀, 25°48′S, 146°35′E, Augathella, 18 Jan 1993 (NMV). 1 juv., 17 km N of Ardmore Stn, 105 km SW of Mt Isa, 27 Sep 1977. ♀, Blackburn, 18 Sp 1905. 2♀, Cunnamulla (all SAM).

NSW. ♀, Broken Hill, Mar 1943. ♂, Calumet, 43 km NE of Binnaway, 23 Dec 1932. 1 juv., Mootwingie, 142 km NE of Broken Hill, 15 Sep 1955. ♂, Stephens Ck, 24 km ENE of Broken Hill, 29 Jan 1976. 2♂, Warrumbungle Nat Pk, 13–18 Dec 1977 (all AM). ♀, Barrington Tops, 1945–6. 3♂, 18 km WNW of Bourke, 9 Feb 1972. ♂, Brewarrina, 1914. ♂, 6 km W of Cobar, 10 Dec 1971. 1 juv., 42 km S of Condobolin, 11 Dec 1962. ♂, Cowra, 15 Feb 1967. ♀, Deniliquin. ♂, Deniliquin, 1 Aug 1961. 1 juv., 22 km SW of Dubbo, 21 Dec 1961. ♀, 15 km W of Dubbo, 22 Dec 1961. ♂, Forbes, 14–15 Nov 1979. ♀, Henty, 18 Jan 1962. 1 juv., 32°30′S, 140°20′E, Kinchega Nat Pk, Jan 1986. ♂, Lake Cowal, 15 Dec 1970. ♂, 30 km S of Lightning Ridge, 27 Dec 1978. 1 juv., 14 km WNW of Monia Gap, nr Hillston, 23 Mar 1972. ♀, Mountain Gap, nr Hillston, 25 Oct 1971. ♂, 12 km NNE of Parkes, 21 Dec 1961. 1 juv., Peak Hill, 14 Sep 1954. ♂, 4♀, 1 juv., 5 km SSE of Reefton, 20 Dec 1961. ♂, Tibooburra, 16 Nov 1949. ♀, 7 km NW of Trangie, 14 Jan 1962. 2♂, Trangie Exp. Stn., 6 km NW of Trangie, 13–21 Sep 1978. 1 juv., 87 km NE of Wentworth, 6 Nov 1962. ♂, Yass, 28 Dec 1928. ♂, 30 km WNW of Wentworth, 1 Jan 1989. ♂, Wittabrenna Ck, N of Tibooburra, 11 Nov 1971 (all ANIC). ♀, Angora Stn, via Booligal, 20 Mar 1965. 1 juv., Broken Hill, Feb 1927. ♂, Broken Hill, 11 Jul 1904. ♂, Menindee Lakes Caravan Park, 26 Dec 1973. (all SAM).

NT. ♀, nr Tobermorey, Sep 1930 (AM). ♂, Alice Springs, 5 Oct 1955. ♂, Alice Springs, 23 Oct 1955. 7♂, 3♂, 23°41′S, 133°52′E, Alice Springs, 3–8 Nov 1988. ♂, 23°41′S, 133°52′E, Alice Springs, 27–28 Oct 1988. 4♂, 23°41′S, 134°15′E, 39 km E of Alice Springs, 25–26 Sep 1978. ♂, 23°41′S, 134°15′E, 39 km E of Alice Springs, 5 Oct 1978. 4♂, 19°24′S, 135°58′E, 15 km SW of Alroy Downs HS, 10 Apr 1976. 1 juv., 25°07′S, 135°30′E, 38 km NNE of Andado HS, 28 Sep 1972. ♂, ♀, 25°17′S, 130°57′E, 10 km WNW of Ayers Rock, 6 Nov 1980. ♂, 21°40′S 133°45′E, 21 km SW of Barrow Creek, 12 Oct 1972. ♂, Barrow Creek Telegraph Stn, 20 Mar 1955. ♂, 24°36′S, 133°12′E, 7 km SW of Henbury HS, 2 Oct 1972. 4♂, 22°18′S, 137°52′E, Illugnarra Waterhole, 90 km SSW of Uradangi, 15 Oct 1978. ♂, Junction Waterhole, Todd River, 10 Oct 1978. ♂, 25°50′S, 133°18′E, Kulgera, 17 Jan 1982. ♀, Mt Everard, Jindalee Site, 45 km NW of Alice Springs, 27 Feb 1987. 6♂, 26°00′S, 131°25′E, 26 km WNW of Mulga Park HS, 18 Jan 1982. ♂, 1 juv., 24°11′S, 134°01′E, Ooraminna Camp, 56 km SE of Alice Springs, 23 Sep 1987. ♂, 23°00′S, 136°08′E, Plenty River, 245 km ENE of Alice Springs, 14 Oct 1978. ♂, 23°42′S, 134°12′E, Ross River Rd, 33 km E of Alice Springs, 3 Nov 1988. 3♂, 20°53′S, 130°25′E, Sangsters Lake, 38 km SE of The Granites Mine, Tanami Desert, 31 Oct 1988. ♂, 24°11′S, 133°31′E, Stuart Hwy, 65 km SSW of Alice Springs, 4 Nov 1988. ♂, ♀, 1 juv., 19°59′S, 129°42′E, Tanami Borehole, Jul-Sep 1971. 1 juv., Tennant Creek, 5 Nov 1965. ♂, ♀, 20°51′S, 130°16′E, 35 km S of The Granites Mine, Tanami Desert, 29 Oct-2 Nov 1988. 2♂, 25°21′S, 131°03′E, Uluru Motel, Ayers Rock, 4, 6 Nov 1980 (all ANIC). 1 juv., 4 km W of Alice Springs, 24 Sep 1987. ♂, 31 km S of Alice Springs, 29 Sep 1987. 2 juv., Ayers Rock, Sep 1948. 1 juv., Glen Helen Gorge, Finke River, 14 Oct 1987. ♀, Kings Canyon Rd, 30 km W of Stuart Hwy, 1 Oct 1987. 1 juv., 20°52′S, 130°16′E, SE of The Granites, Tanami Desert, 27–31 Oct 1987 (all NMV). ♂, Alice Springs, Horn Expd., 1894. ♂, Alice Springs, June 1894. ♀, Petermann Range. ♂, Tennant Creek (all SAM). ♂, Prouse Gap, 150 km N of Alice Springs, 4 Oct 1969 (WAM).



Figures 81–82, *Archimantis sobrina*. 81, male; 82, female. Scale = 10 mm.



Figures 83–92, *Archimantis sobrina*. 83, male head; 84, female head; 85, male cercus; 86, female cercus; 87, ootheca, lateral; 88, ootheca, dorsal; 89, ootheca, transverse; 90, male genitalia, dorsal; 91, male genitalia, ventral; 92, male genitalia, right lateral. Scale = 2 mm.

SA. ♀, Alarinna, Musgrave Ranges. ♂, Arkaroola, Flinders Ranges, 22 Jan 1976. ♂, Innamincka, Coopers Creek, 24 Jan 1976 (all AM). 2♂, 26°08′S, 130°54′E, 25 km NW of Amata, Musgrave Ranges, 19 Jan 1982. 1 juv., 5 km SE of Goolwa, 19 Jun 1951. ♀, 23 km NE of Hawker, 24 Jan 1959. ♂, 33°07′S, 136°38′E, 20 km NE of Kimba, 5 Oct 1982. ♂, 12 km S of Kimpton, 7 Jan 1989. 1 juv., 38 km SSE of Marree, 24 Jul 1956. 1 juv., 27 km NNW of Padthaway, 13 Mar 1953. ♀, 10 km E of Penong, 6 Jan 1972. ♀, 1 juv., 35°24′S, 140°48′E, 18 km SSW of Pinnaroo, 25 Oct 1983. 1 juv., 16 km ESE of Poochera, 30 Oct 1969. 1 juv., 27 km NW of Port Augusta, 12 Jul 1956. 2 juv., 13 km SW of Quorn, 27 Jul 1956. ♂, Roseworthy Agricultural College, nr Gawler, Dec 1972. ♂, 32°20′S, 138°36′E, Slippery Dip Camp, Brachina Creek, 9 Nov 1987. 1 juv., Urrbrae, Aug 1946. ♂, Urrbrae, Jun 1956. ♂, 6 km S of Wintinna HS, 5 Feb 1984 (all ANIC). 1 juv., Abminga RS, 22 Sep 1987. 1 juv., Alberrie Creek RS, 40 km W of Marree, 17 Sep 1987. ♀, edge of Lake Frome, 16 May 1977. 1 juv., 31 km NW of William Creek, 18 Sep 1987. 2 juv., 0.5 km W of Yappala HS, N of Hawker, 16 Sep 1987 (all NMV). 12♀, 4 juv., Adelaide. ♀, Adelaide, 21 Dec 1892. ♀, Adelaide, 23 Feb 1896. 1 juv., Adelaide, 26 Jul 1886. ♂, Adelaide, 6 Nov 1959. ♂, nr Agnes Creek Stn, 11 Oct 1977. ♀, 30°22′S, 137°08′E, Andamooka Stn, Apr 1981. 4♂, Anna Creek HS, 6 Dec 1974. 1 juv., Arcoona Creek, Gammon Ranges, 17 Sep 1956. 1 juv., Birkinhead. ♂, Black Swamp, 5 Dec 1952. ♂, Brachina Gorge, Flinders Ranges, 13 Dec 1974. ♂, Brighton, 12 Nov 1901. ♂, Brinkworth. 1 juv., Buckleboo. ♂, Carappee Hill, Eyre Penninsula, 8 Nov 1964. ♂, Ceduna. ♀, Ceduna, Jan 1924. 1 juv., Clayton Crossing, 29 Jul 1955. ♀, Coomandook, ♂, Coopers Creek Ferry Crossing, 30 Nov 1974. 1 juv., Cortina Stn, Jan 1968. ♂, Eden Hills, 28 Jan 1956. ♀, nr Frasers Hut, Cariewerloo Stn, March 1956. ♂, Dalhousie Springs, 6 Oct 1980. ♂, Finniss Springs HS, 7 Dec 1964. ♂, Frome River, nr Marree, 25 Oct 1956. 1 juv., Gammon Range Nat Pk, Arcoona Creek, 5 May 1989. ♂, Glenunga HS, 4 Dec 1932. 4 juv., Glenunga, 9 Sep 1932. ♀, Goodwood, 14 Jan 1964. ♀, Goodwood Park, 19 Nov 1888. ♂, Grange. ♂, Hilton, 30 Dec 1956. ♀, Islington, 15 Nov 1886. ♂, Kensington Park, 10 Nov 1980. 1 juv., Lake Arcoona, 3 Jan 1900. ♂, Lake Callabonna, 1893. ♀, Lake Mulligan, 1893. ♀, Lake Palankarinna, 3 Mar 1972. 2♂, Leigh Creek, 18 Nov 1890. ♂, 28°19′S, 136°16′E, Levi Creek, 8 km NW of Ely Perry Spring, 7 Dec 1974. ♀, Loxton, 30 Dec 1955. ♂, Loxton, 26 Nov 1956. ♀, Loxton, 26 Dec 1955. ♂, Lucindale. 1 juv., 29°11′S, 134°19′E, 2 km SW of Mabel Creek HS, 28 Oct 1984. ♀, Marree. ♂, Marree Racecourse, 1 Dec 1974. ♂, 32°57′S, 137°24′E, Middleback Stn, 12 Nov 1983. ♀, 32°57′S, 137°24′E, Middleback Stn, 12 Feb 1984. ♂, Mitcham, 16 Nov 1978. 1 juv., Mitcham, 23 Mar 1979. ♀, Mitcham, 30 Nov 1979. ♂, Mt Davies, 18 Nov 1966. ♀, Mt Lofty Range. ♀, Murat Bay. ♀, Murray River. ♀, Normanville, Nov 1933. ♀, Ooldea, 30 Apr 1898. 2♀, Ooldea. ♂, ♀, 2 juv., Orroroo, 1942–44. ♂, Paddington, Outer Harbour, Nov 1933. ♂, Parkside. 1 juv., Poochera, 13 Jun 1956. ♂, 2 juv., Purple Downs, Pimba, 12 Dec 1937. ♂, Port Lincoln district, 16 Oct 1957. ♂, Quorn, Dec 1893. ♀, Thebarton, 2 Jan 1960. ♂, Unley, Jan 1883. ♀, Warradale. 1 juv., Wilpena Nat Pk, 10 May 1989. 1 juv., 7 km W of Wilson, 9 May 1956. 2♀, Yeelana. ♂, Yurgo (all SAM).

Vic. 1 juv., 12 km NNW of Annuello, 5 Nov 1962. ♂, Kyabram, 26 Oct 1946. ♀, Melbourne, 1966. ♂, 35°04′S, 143°11′E, 11 km W of Piangil, 27 Oct 1973 (all ANIC). ♀, 34°46′S, 142°31′E, 30 km WNW of Annuello, 20 Oct 1985. ♀, Chelsea, 23 Jan 1918. ♂, Cheltenham, 13 Dec 1905. ♀, 2.8 km NNW of Chinamans Well, Big Desert, 12 Oct 1982. ♀, Downshore Rd, Elsternwick, 5 Jan 1908. ♀, Falls Creek Village, 15 Mar 1984. ♂, ♀, Frankston. ♂, Gippsland. ♂, Glenelg River, 7 km NNE of Nelson, 25 Nov 1966. ♂, Hattah Lakes. Feb 1983. 3♂, ♀, Hattah Lakes Nat Pk, 21 Oct 1982. ♂, 34°54′S, 142°08′E, 19 km SW of Hattah, 17 Oct 1985. 1 juv., 3446′S, 14220′E, 5 km E of Hattah, 22 Oct 1985. ♂, Laverton, Sep 1977. ♂, 5♀, Lurg, E of Benalla, Mar 1977. ♂, ♀, 3 juv., 0.2 km N of Milmead Rock, Big Desert, 20 Mar 1987. ♀, Mordialloc. ♀, 35°24′S, 141°09′E, 15.9 km SSW of Murrayville, 19 Feb 1987. ♂, Oakleigh, 1902. ♀, Redcliffs, 19 Mar 1928. ♀, 8.1 km N of Round Swamp, Big Desert, 28 Mar 1985. ♀, Sandringham, 1892. ♂, Tallangatta, 24 May 1904. 1 juv., Whipstick, 11 Apr 1948. ♀, Old Tom Rd, Whipstick Forest, N of Bendigo, 17 Feb 1985 (all NMV).

WA. ♂, ♀, Bornholme, 8 Dec 1921. 2♂, Karratha, 25 Oct 1978. ♂, 50 km SW of Sanfire Flat, bn Broome and Port Hedland, 29 Oct 1978 (all AM). ♂, Balgo Hills, 16 Oct 1985. 1 juv., Bohemia Ridge, E of Christmas Creek HS, 22 Oct 1969. ♀, Broge Hill, 160 km S of Halls Creek, 25 Sep 1985. 1 juv., 15 km SW of Cocklebiddy, 3 Nov 1969. 1 juv., 32°08′S, 126°18′E, 23 km ESE of Cocklebiddy, 25 Oct 1977. ♂, 30°09′S, 115°07′E, Cockleshell Gully, 19 km NNE of Jurien, 25 Oct 1984. 1 juv., 31°28′S, 120°50′E, 67 km SSW of Coolgardie, 6 Nov 1969. ♀, Cutler Rd, Jandakot, Mar–Apr 1982. ♂, 26°01′S, 113°35′E, 12 km SSE of Denham, 22 Oct 1984. 1 juv., 29°20′S, 115°01′E, 12 km SE of Dongara, 11 Sep 1981. ♂, 29°16′S, 114°55′E, 3 km SSW of Dongara, 15 Oct 1970. ♂, Eneabba, 7 Oct 1981. ♂, ♀, 1 juv., 32°08′S, 126°17′E, Eyre Tower, Microwave Stn, 22 km ESE of Cocklebiddy, 7 Oct 1982. ♂, 2♀, 33°42′S, 123°26′E, Fisheries Rd, 2 km ESE of Price Hill, Cape Arid Nat Pk, 15 Oct 1982. 2♀, 27°50′S, 114°43′E, Four Mile Pool, Murchison River, 23 Oct 1984. 1 juv., Fremantle, 12 Aug 1934. 1 juv., 28°47′S, 114°34′E, Geraldton, 1 May 1971. 2 juv., 27°49′S, 114°11′E, nr Grandstand Rock, 12 km SE of Kalbarri, Kalbarri Nat Pk, 19 Oct 1984. ♀, 31°53′S, 116°05′E, John Forrest Nat Pk, Darling Ranges, 28 Oct 1985. ♂, 33°23′S, 123°24′E, Junana Rock, 9 km NW of Mt Ragged, 26 Oct 1977. ♂, 30°13′S, 115°18′E, 28 km ENE of Jurien, 26 Oct 1984. ♀, 30°54′S, 121°32′E, 21 km SSE of Kalgoorlie, 17 Feb 1978. ♀, 14 km W of Kitchener, 15 Jan 1974. ♂, Lake Douglas, 12 km SW of Kalgoorlie, 13 Jan 1989. ♀, 27°34′S, 114°26′E, Loop Rd, 30 km ENE of Kalbarri, Kalbarri Nat Pk, 17 Oct 1984. 2♀, 2 juv., 27°39′S, 114°17′E, Loop Rd, 14 km ENE of Kalbarri, Kalbarri Nat Pk, 20 Oct 1984. ♀, 21°34′S, 117°03′E, 3 km WNW of Millstream HS, 23 Apr 1971. ♂, 21°35′S, 117°12′E, 15 km E of Millstream HS, 20 Oct 1970. ♂,

2210′S, 11502′E, 20 km S of Minderoo HS, 17 Oct 1970, 1 juv., 33°41′S, 123°10′E, 8 km NW of Mt Baring, SW of Mt Ragged, 16 Oct 1982. ♀, 35°01′S, 117°54′E, Mt Clarence, Albany, 13 Feb 1980. ♀, Mt Hawthorn, 10 Nov 1953. ♂, 3♀, 1 juv., 33°59′S, 122°08′E, 1 km NNW of Mt Le Grand, Cape Le Grand Nat Pk, 11 Oct 1982. 4♂, 5 km SW of Mt Ragged, 12 Nov 1969. ♀, 1 juv., 33°56′S, 119°59′E, Mylies Beach, Fitzgerald Nat Pk, 31 Oct 1984. ♂, 25°11′S, 113°50′E, nr New Beach, 40 km SSE of Carnarvon, 21 Oct 1984. 1 juv., Ninghan Stn, 20 Jul 1963. 1 juv., 32°09′S, 121°43′E, 7 km WNW of Norseman, 13 Oct 1984. 1 juv., 34°14′S, 115°12′E, Pinnacles/Cervantes, 2–5 Mar 1982. 1 juv., 33°37′S, 120°24′E, 33 km E of Ravensthorpe, 10 Feb 1980. ♂, 58 km N of Reid, Nullarbor, 4 Feb 1968. 1 juv., Rottnest Island, 22 Jun 1975. ♂, Scadden, 21 Oct 1977. ♂, ♀, 34°26′S, 117°56′E, Stirling Range Nat Pk, 50 km SSW of Borden, 12 Jan 1980. ♀, 3351′S, 12301′E, Thomas River, 23 km WNW of Mt Arid, Cape Arid Nat Pk, 13 Oct 1982. ♂, 1 juv., 32°35′S, 117°19′E, Tutanning Nature Reserve, 22 km SE of Pingelly, 16–17 Sep 1981. ♀, 23°13′S, 114°26′E, 13 km WSW of Winning HS, 29 Apr 1971. ♂, 43 km NW of Wittenoom, 22 Apr 1963 (all ANIC). ♀, Middalya, 17 Aug 1904. ♂, ♀, Wembley, 18 Nov 1948 (all NMV). ♀, 1 juv., Beverley. ♀, Mt Giles Weather Station, Nov 1966. ♀, Mullewa. 2♂, Nanga, neck of Peron Penninsula, 3 Aug 1972. ♀, Roebourne, 1 Mar 1899. ♂, 17 km SW of Three Springs, 7 Nov 1968 (all SAM). ♂, Applecross, 28 Nov 1963. 1 juv., Bickley, 2 Sep 1965. ♂, Deepdene, Karridale, 10 Aug 1962. 1 juv., Dumbleyung, 31 Mar 1963. ♀, Dumbleyung, 19 Dec 1963. 1 juv., Kalamunda, 7 Dec 1962. 1 juv., Kelmscott, 14 Apr 1971. 1 juv., Lake Brown. ♀, Laverton, 26 Nov 1964. 1 juv., 33°01′S, 120°44′E, McDermid Rock, 27 Sep-3 Oct 1978. ♂, 28 km NE of Millstream, 26 May 1965. ♂, Mt Hawthorn. 2 juv., 30°59′S, 119°07′E, 13.6 km SSW of Mt Jackson, 5–11 Sep 1979. ♀, Mt Pleasant, 26 Oct 1963. ♀, Mt Pleasant, 1 Dec 1963. ♂, Mt Tom Price, Mar 1966. 2♂, Mullewa, 1914. ♀, Murchison district. ♀, Murdock, 27 Jan 1978. ♀, Nedlands, Nov 1969. ♀, Peringillup, Dec 1913. ♂, Perth. ♂, Perth, Oct 1914. ♂, South Perth, 26 Dec 1972. ♀, Walyhomoning Rock, May 1972. ♂, Warburton Ranges, Dec 1962. ♂, Wembley Downs, 1 Nov 1969. ♀, West Perth. ♀, West Subiaco. ♀, Yandil (all WAM).

Diagnosis. Eyes with lateral margins rounded, lateral margins of pronotum not strongly toothed, fore coxa without large teeth on anterior margin or distinctly patterned inner face, tegmina of female covering first two abdominal tergites, apical segment of cercus with pointed to rounded margin, pa of male genitalia compact.

Description. Body of moderate to large size, colour brown, yellow brown or green. Apical margin of head broadly arched, eyes slightly protuberent anteriorly with lateral margins rounded, frontal shield with distinct subantennal ridge. Prothorax elongate, rather broad in larger specimens, supracoxal expansion slight but distinct; lateral margins finely denticulate in prozona and smooth in metazona of male, similar in female except anterior third of metazona finely denticulate; prozona with small scattered tubercles dorsally, denser more pronounced tubercles ventrally; metazona smooth with distinct mid dorsal keel. Fore coxa with 6–7 very small teeth on anterior margin, females with smaller tubercles between teeth particularly proximally; inner face without distinct patterning, pale proximally. Fore femur with all spines tipped blackish brown. Fore tibia with 13–16 inner and 10–11 outer spines, all tipped blackish brown. Mid and hind femora without genicular spine. Tegmina and hindwings of male reaching to caudal margin of eighth abdominal segment to just beyond supraanal plate; tegmen hyaline except for costal area and costal margin of discoidal area which are opaque and of similar colour to body above; beneath costal margin of discoidal area intense orange-brown, costal area glossy black in proximal fifth, remainder whitish with black cross veins; discoidal area occasionally with dark spot proximal of stigma dorsally, venation unpigmented to slightly pigmented. Tegmina and hind wings of female just reaching caudal margin of second abdominal tergite; tegmen of similar colour to male except that opaque portion of discoidal area more extensive, occasionally with blackish spot at distal end of stigma and veins of discoidal area sometimes darkly pigmented. Hindwings of both sexes with costal margin orange-brown, remainder hyaline. Abdomen usually with narrow, whitish mid dorsal stripe; anterior margin of abdominal sternites 3–6 coloured black and red, only visible when abdomen flexed dorsally; cerci (figs 85–86) elongate, apical segment with pointed to rounded margin. Male genitalia (figs 90–92) with dpr of vp strongly curved, broad at base, narrowing toward tip; anterior part of vl of lph broadly rectangular, narrowly produced at junction with pa; apr swollen medially, tip slightly mucronate; pa compact and strongly shagreened, with two lateral projections, anterior one knob like, posterior one similar but slightly longer and more pointed with small tooth at apex.

Measurements (mm). Body length, ♂ 70–100, ♀ 70–110. Head width, ♂ 6.5–10.2, ♀ 9.0–11.4. Head depth, ♂ 3.8–5.1, ♀ 5.7–7.4. Pronotum width, ♂ 3.5–5.7, ♀ 5.0–7.9. Pronotum length, ♂ 22–31, ♀ 22–38. Fore coxa length, ♂ 12–17,

♀ 13–21. Fore femur length, ♂ 14–20, ♀ 16–25. Tegmen length, ♂ 48–60, ♀ 16–24. Cercus length, ♂ 7.4–9.5, ♀ 7.0–11.2.

Immature stages. Nymphs occasionally with more mottled colour pattern than adults. Ootheca (figs 87–89) roughly globular oblong, emergence area often protruding somewhat posteriorly, spongy layer rather narrow so that ootheca appears smaller than that of *A. latistyla*, eggs arranged in W formation, colour whitish or pale greenish; deposited on the stems of shrubs and tall grasses, often parasitized by wasps of the genus *Podagrion*.

Distribution and habits. Occurs over the drier regions of mainland Australia, absent from the monsoonal north and the eastern side of the Great Dividing Range but extends into wetter regions in the south east and south west (fig. 171). Found on shrubs and tall grasses, rests with underside uppermost, adults most commonly collected from October to January.

Remarks. Saussure's types for this species cannot be located (Balderson, 1984). This is a widely distributed and variable species. Northern specimens become larger and the prothorax becomes broader, in contrast to that of *A. latistyla* which becomes more elongate. Specimens from the southwest are rather small, brown in colouration, lack the dorsal abdominal stripe and have the apical segment of the cercus with a rounded margin. These are probably adaptations to a more shrub dominated habitat, similar though less pronounced characters are found in specimens from the Big Desert region of Victoria, a predominately shrubby region. The southwestern form was described as a seperate species, *A.minor*, by Giglio-Tos (1917) however this form grades gradually into the more typical form to the north and west and is considered a mere variant.

Archimantis armata Wood-Mason

Figures 93–101, 172

Archimantis armatus Wood-Mason, 1877: 76.
A. armata Wood-Mason, 1878: 584.

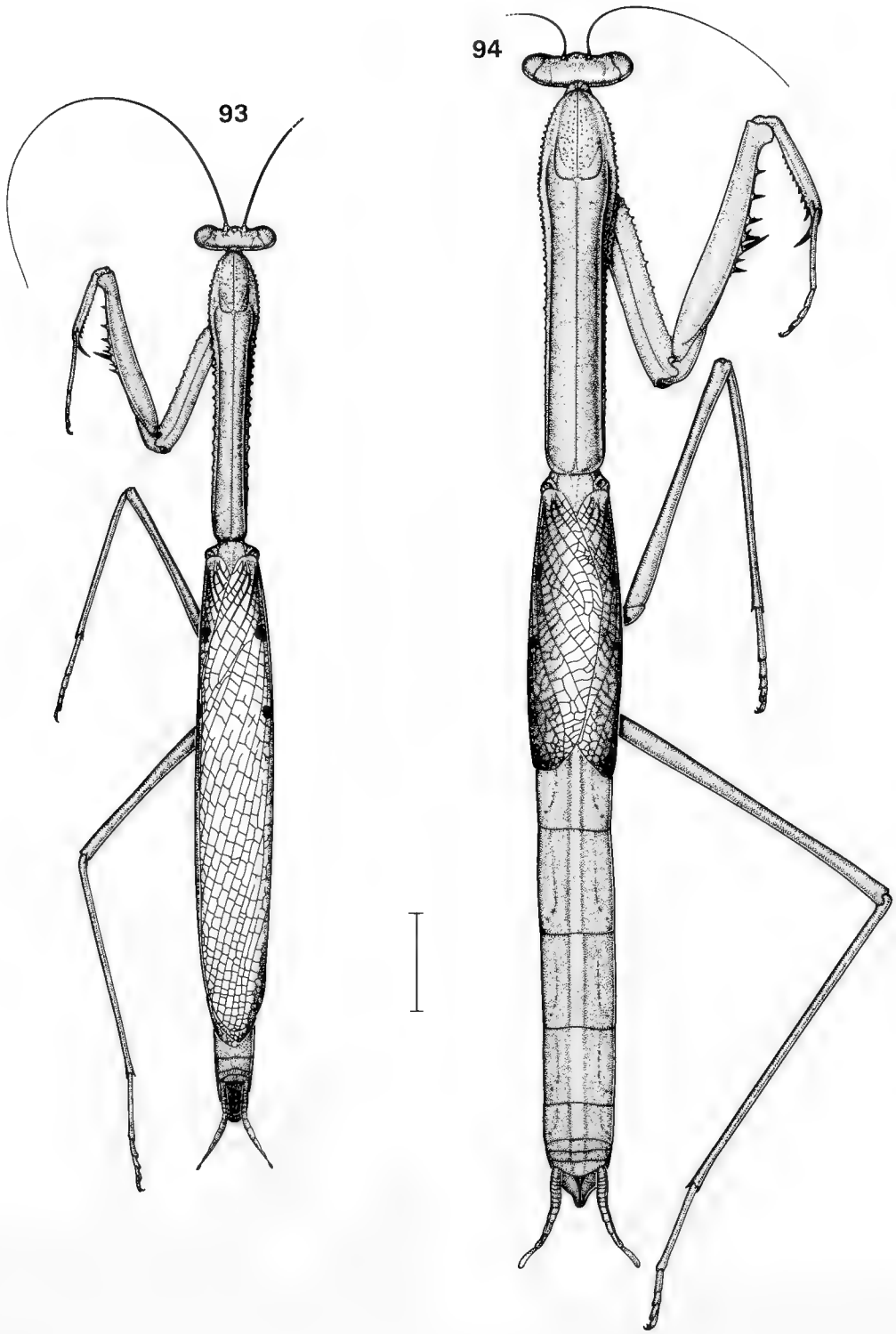
Material examined. Holotype female of *A. armatus*, North Australia, C. French, 587/1 (ZSIC, in alcohol).

Other specimens examined (15♂, 10♀, 5 juv.). Qld. ♂, Clermont, Apr 1921. ♂, Clermont, 7 Feb 1981 (both AM). 1 juv., 20 km W of Arcadia HS, 24 Oct 1967. 1 juv., 25 km N of Bell, 27 Oct 1967. ♀, Blackall, 22 Apr 1972. ♂, Black River, 20 km N of Townsville, 20 Jul 1990. 1 juv., Bundaberg, Apr 1971. ♂, Electra, nr Bundaberg, 25 Apr 1978. ♂, Issacs River Crossing, Dingo-Mt Flora Rd, 24 Jan 1982. ♂, Mackay, 4May 1971. 1 juv., 25°36′S, 151°44′E, Oaky Creek, 14 km N of Gayndah, 19 Apr 1982. 2 juv., Wild Horse Swamp, 25 km SW of Rolleston, 25 Oct 1967 (all ANIC). ♀, Emerald (QM). 2♀, Brisbane, 12 Oct 1915. ♂, 19°38′S, 146°50′E, 6.5 km N of Calcium, 18 Feb 1989. ♂, Roma, 9 Jan 1984. ♂, Townsville, 6 May 1975. ♀, Townsville, 1 Jul 1934 (all NMV). ♀, Childers. 2♂, Mitchell, 3–4 Jan 1974. ♂, Somerset (all SAM). ♀, Banana, 10 Dec 1961. ♀, Banana, 10 Feb 1964. ♂, Coalstoun Lakes, Feb 1961. ♂, Dalby, 25 May 1951. ♀, Yuleba, Jan 1964 (all UQ).

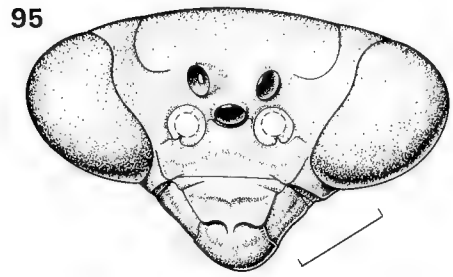
NSW. ♀, Moree, 26 Dec 1951. ♂, Pallal Ck., 17 km Sw of Bingara, 5–6 Jan 1956 (both ANIC).

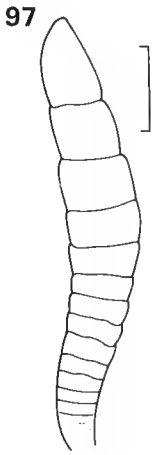
Diagnosis. Eyes with lateral margins rounded, pronotum with distinctly toothed lateral margins which are slightly lamellate anterior to coxal insertion, fore coxae without large teeth on anterior margin or distinctive pattern on inner face, tegmina of female covering first 2½ abdominal tergites, apical segment of cerci with rounded margin, pa of male genitalia compact with single pointed projection.

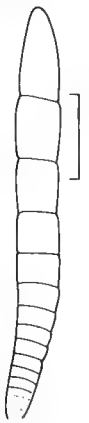
Description. Body large, elongate and rather robust, brown in colour. Apical margin of head broadly arched, eyes slightly protuberent anteriorly with lateral margins rounded, frontal shield with distinct subantennal ridge. Prothorax elongate, slight but distinct supra coxal expansion, lateral margins distinctly though rather finely toothed and slightly lamellate anterior to coxal insertion; prozona with few scattered tubercles above, more numerous and much more pronounced tubercles beneath which are often paler than surrounding area; ventral area between coxal insertion creamish surrounded by mauvish grey; metazona with distinct mid dorsal keel. Fore coxa with 6–8 small teeth on anterior edge, inner face not distinctly patterned. Fore femur with all spines tipped blackish brown, shallow pit on ventral face near fourth discoidal spine for reception of terminal outer tibial spine. Fore tibia with 15–17 inner spines and 10–13 outer spines, all tipped blackish brown. Mid and hind femora without genicular spine. Wings of male reaching to about caudal margin of abdominal segment seven. Tegmen hyaline except for costal area and costal margin of discoidal area which are opaque brown above; below costal area black in proximal fifth, remainder whitish with black cross veins, costal margin of discoidal area orange brown; stigma bounded proximally and distally by dark spot on dorsal surface. Hindwing with costal area orange brown, remainder hyaline.

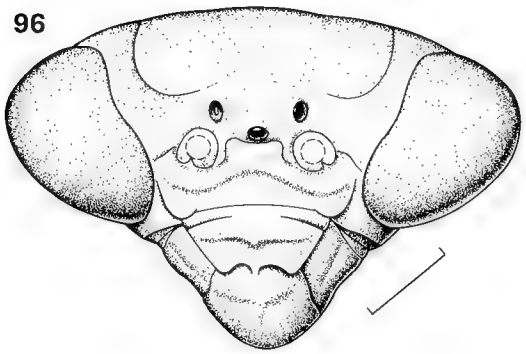


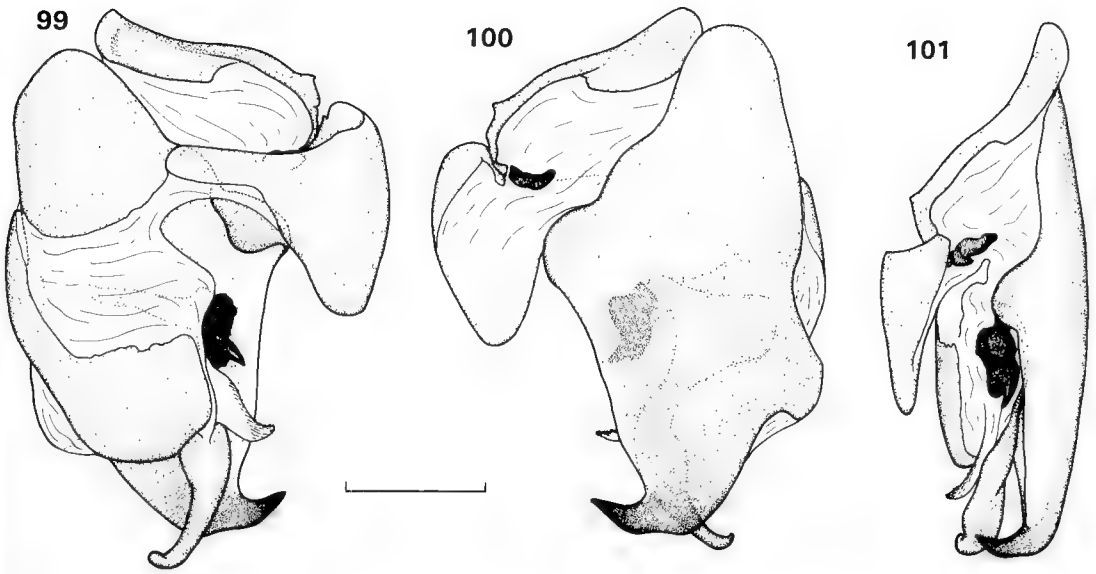
Figures 93–94, *Archimantis armata*. 93, male; 94, female. Scale = 10 mm.











Figures 95–101, *Archimantis armata*. 95, male head; 96, female head; 97, female cercus; 98, male cercus; 99, male genitalia, dorsal; 100, male genitalia, ventral; 101, male genitalia, right lateral. Scale = 2 mm.

Wings of female covering first 2½ abdominal tergites. Tegmen similar to male except discoidal area completely opaque brown with veins rather darker brown. Hindwing with marginal coloured area slightly more extensive and veins darker coloured, particularly apically. Abdomen without distinct pale mid dorsal abdominal band, anterior margin of abdominal sternites 3–6 blackish, apical segment of cercus (figs 97–98) with rounded margin. Male genitalia (figs 99–101) with dpr of vp very broad at base, strongly curved, narrow toward tip; anterior section of vl of lph broadly rectangular, narrowly produced at junction with pa; apr swollen medially, tip slightly mucronate; pa compact, surface folded and strongly shagreened with single large glabrous tooth projecting posterio-laterally.

Measurements (mm). Body length, ♂ 85–94, ♀ 103–112. Head width, ♂ 5.4–8.2, ♀ 9.2–10.2. Head depth, ♂ 4.5–4.6, ♀ 6.0–7.4. Pronotum width, ♂ 4.3–5.0, ♀ 6.0–7.3. Pronotum length, ♂ 28–29, ♀ 36–37. Fore coxa length, ♂ 14–15, ♀ 19–21. Fore femur Length, ♂ 16–17, ♀ 21–24. Tegmen length, ♂ 49, ♀ 29–30. Cercus length, ♂ 9.5–11.5, ♀ 11.0–12.0.

Immature stages. Nymphs have a pale mid dorsal stripe but it is not as prominent as in some other members of the genus. The toothed margins of the pronotum are not apparent in very early instars. The ootheca is unknown.

Distribution and habits. Recorded from far north eastern New South Wales and eastern Queensland as far north as Townsville (fig. 172). Nothing is known of the habits of this species but it is probably a shrub dweller.

Remarks. This species is not well represented in collections considering its distibution covers some fairly well populated areas and may not be common in nature.

Archimantis monstrosa Wood-Mason

Figures 102–110, 172

Archimantis monstrosa Wood-Mason, 1878: 583.
Archimantis latizonata Sjöstedt, 1918: 21.

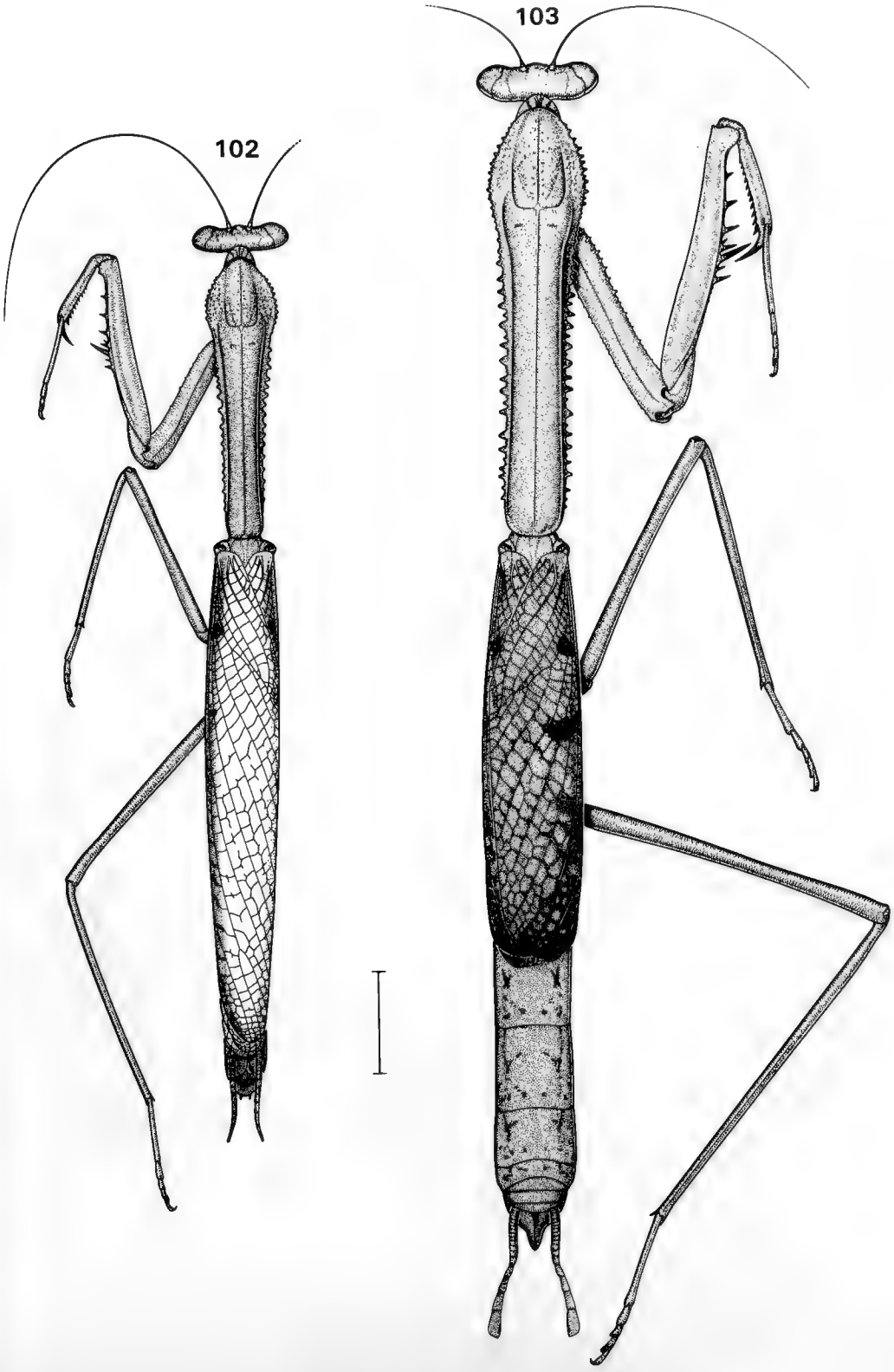
Material examined. Holotype female of *A. monstrosa*, Victoria River, North Australia (Northern Territory), 10 Mar 1856, R.Elsey Esq., 57.134 1 (BMNH).

Other specimens examined (20♂, 3♀, 38 juv.). Qld, ♂, 17°20′S, 14457′E, Emu Ck, 27 km SW of Dimbulah, 25–26 Nov 1981. ♂, 18°10′S, 140°15′E, Flinders River, 59 km SW of Normanton, 1 Dec 1981. ♂, 17°25′S, 145°05′E, 15 km W of Irvinebank, 27–28 Nov 1981 (all ANIC). ♂, 17°13′S, 145°17′E, 5.5 km N of Collins Weir, W of Atherton, 10 Feb 1989. 2♂, 17°51′S, 141°08′E, Glenore Pumping Station, Norman River, 13 Jan 1993. 1 juv., 19°33′S, 140°51′E, Julia Creek Rd., Dugald River crossing, 15 Jan 1993. ♂, Karumba, 7 Apr 1989. ♀, 18°43′S, 144°38′E, Kennedy Development Rd, Spring Creek HS turnoff, 17 Apr 1991. 2♀, 21 km SSW of Mt Garnet, 11 Apr 1991. ♂, 17°38′S, 141°09′E, 0.5 km S of Wills Ck., NE of Normanton, 11 Jan 1993 (all NMV). ♂, 8♀, 5 juv., Mornington Island Mission, 20–21 May 1963 (SAM).

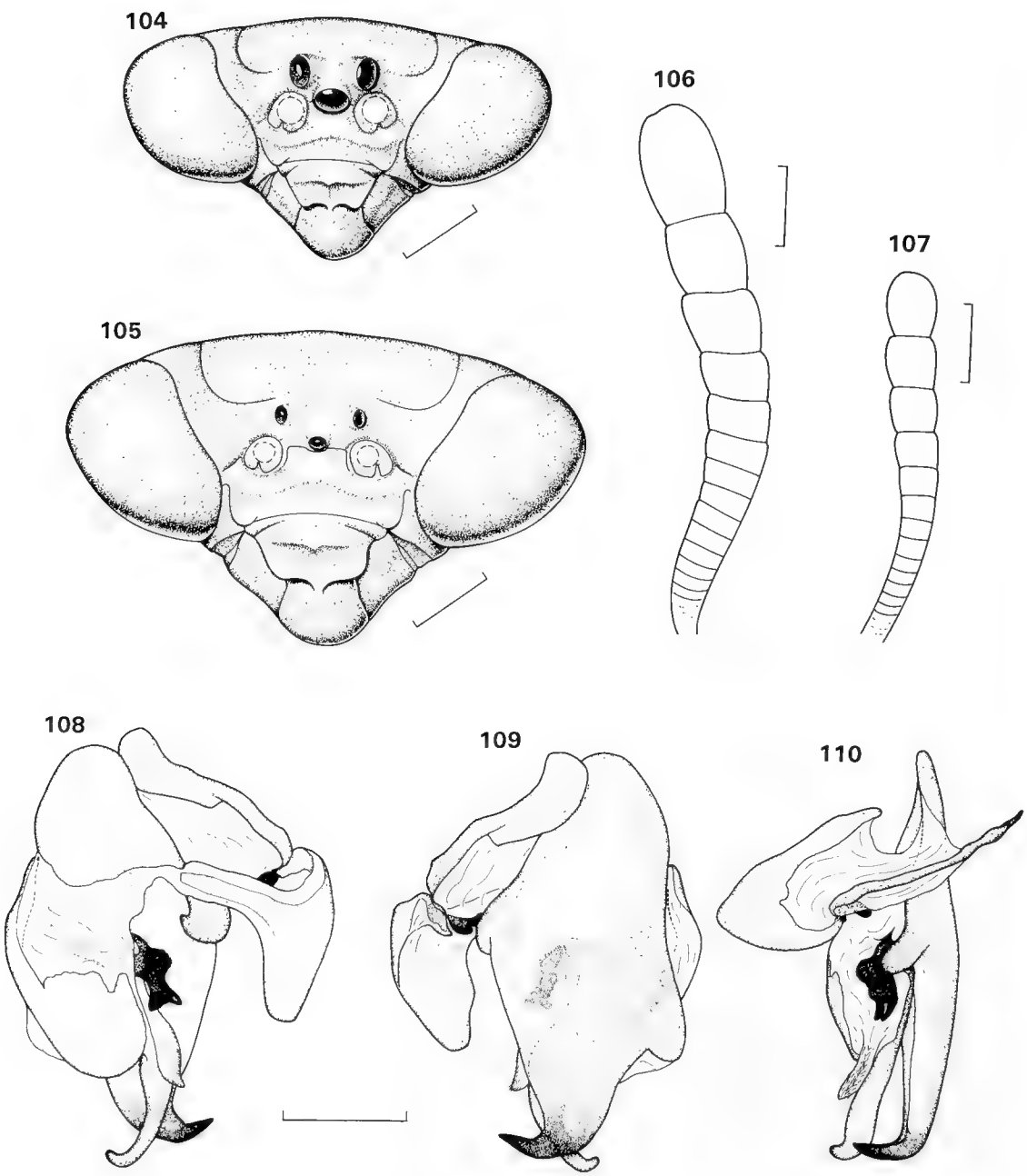
NT. 1 juv., MacArthur River, 18 Jun 1976. ♂, ♀, Nhulunbuy, Feb 1973. ♂, ♀, Nhulunbuy, Mar 1973. ♀, Nhulunbuy, Feb 1974. 1 juv., Port Keats, 20 Jun 1952 (all AM). 1 juv., 8 km NW of Adelaide River, 10 Jun 1972. ♂, 16°19′S, 136°05′E, 36 km SW of Borroloola, 4 Nov 1975. 1 juv., 16°28′S, 136°08′E, Bukalara Range, 47 km SSW of Borroloola, 23 Apr 1976. ♂, 12°25′S, 132°59′E, 3 km ENE of Cahills Crossing, East Alligator River, 12 Nov 1972. 1 juv., 2 km NW of Cahills Crossing, East Alligator River, 14 Sep 1982. 1 juv., 5 km W of Jabiru, 7–10 Feb 1983. 1 juv., 16°23′S, 129°31′E, 13 km WNW of Kildurk HS, 29 Jul 1969. ♀, Koongarra, 15 km E of Mt Cahill, 6 Apr 1973. 1 juv., 12°50′S, 132°51′E, 16 km NE of Mt Cahill, 13 Jun 1973. 2 juv., 15 km SW of Mudginberri HS, 31 Aug 1982. 1 juv., Patonga Rd, 12 km WSW of Mt Cahill, 14–15 Sep 1981. ♂, 11°07′S, 132°08 E', Smith Point, Cobourg Peninsula, 27 Jan 1977. 2♂, Tindal, 30 Nov 1967. 2♂, 14°31′S, 132°22′E, Tindal, 13 km ESE of Katherine, 2 Dec 1967. ♂, 3♀, Tindal, 17 Dec 1967. 1 juv.°, 16°24′S, 131°02′E, 3 km ENE of Victoria River Downs HS, 2 Jun 1969. 1 juv., 16°12′S, 130°26′E, 70 km WNW of Victoria River Downs HS, 25 Jun 1968. 1 juv., Borroloola, McArthur River, 16 Jun 1929. ♀, 11°08′S, 132°09′E, 2 km SE of Smith Point, Cobourg Peninsula, 5 Feb 1977 (all ANIC). 1 juv., Darwin, 7 Aug 1912 (NMV). 2♀, 4 juv., Darwin. ♀, 1 juv., Groote Eylandt. ♀, Northern Territory. 4♀, 1 juv., Roper River. ♂, Stapleton (all SAM).

WA. 1 juv., 17–25 km NNE of Bedford Downs HS, 1–8 Jul 1964. 1 juv., 17°19′S, 122°10′E, 8 km S of Cape Bertholet, West Kimberley District, 19 Apr 1977. 1 juv., 14°39′S, 126°57′E, Drysdale River, Kimberley District, 18–21 Aug 1975. 2 juv., 18 km E of Gibb River HS, Kimberley District, 21 Jun 1979. 1 juv., 14°17′S, 126°39′E, Kalumburu, 13 Jun 1985. ♀, Kimberley Research Stn, 10 Dec 1951. ♂, Kimberley Research Stn, 3 Mar 1962. 1 juv., 14°49′S, 125°42′E, Mitchell River Falls, Kimberley District, 12 May 1983. 1 juv., 14°37′S, 125°48′E, 8 km SW of Walsh Point, Admiralty Gulf, 17 May 1983. ♀, Wyndham. ♀, Wyndham, 17 Dec 1930 (all ANIC). ♀, 3 juv., Wotjulum, Sep 1955 (WAM).

Diagnosis. Eyes with lateral margins rounded, pronotum with strongly toothed margins which are broadly lamellate anterior to coxal insertions, fore coxa without large teeth on anterior margin or distinctive pattern on inner face, tegmina of female covering first 3½ tergites of abdomen, apical segment of cercus with rounded margin, pa of male genitalia compact with double pointed projection.



Figures 102–103, *Archimantis monstrosa*. 102, male; 103, female. Scale = 2 mm.



Figures 104–110, *Archimantis monstrosa*. 104, male head; 105, female head; 106, female cercus; 107, male cercus; 108, male genitalia, dorsal; 109, male genitalia, ventral; 110, male genitalia, right lateral. Scale = 2 mm.

Description. Body large elongate and robust, brown in colour. Apical margin of head broadly arched, eyes slightly protuberent anteriorly with lateral margins rounded but slightly angular, frontal shield with distinct subantennal ridge. Prothorax elongate, marked supracoxal expansion; lateral margins strongly toothed and distinctly lamellate anteriorly, strongly tuberculate ventrally anterior to coxal insertion; metazona with distinct mid dorsal keel; prozona with few scattered tubercles dorsally, denser more pronounced tubercles ventrally which are paler than surrounding area. Fore coxa with 6–8 small teeth on anterior margin, inner face not distinctly patterned. Fore femur with all spines blackish. Fore tibia with 10–11 external and 14–16 internal spines, all tipped blackish brown. Mid and hind femora without genicular spine. Wings of male not quite covering abdomen. Tegmen hyaline except for costal area and costal margin of discoidal area which are opaque brown above; below costal margin of discoidal area orange brown, costal area glossy black in proximal fifth, remainder whitish with black cross veins; discoidal area with dark spot dorsally at either end of stigma. Hindwing with costal area orange brown, remainder hyaline. Wings of female covering first 3½ tergites of abdomen. Tegmen similar to that of male but discoidal area completely opaque with venation darkly pigmented. Hindwing with orange brown area more extensive and venation more darkly coloured, particularly apically. Abdomen lacking pale mid dorsal stripe, anterior margin of abdominal sternites 3–6 blackish but only visible when abdomen flexed. Cercus (figs 106–107) elongate, apical segment with rounded margin, distal segments relatively broader than those of *A.armata*. Male genitalia (figs 108–110) with dpr of vph broad at base, strongly curved, narrow toward tip; medial lobe strongly produced slightly mucronate; anterior section of vl of lph broadly rectangular, narrowly produced at junction with pa; apr swollen medially, tip slightly mucronate; pa compact, strongly shagreened with two short tooth like projections, one directed posteriorly, the other posteriolaterally.

Measurements (mm). Body length, ♂ 90–97, ♀ 115–117. Head width, ♂ 8.8–9.5, ♀ 11.0–11.6. Head depth, ♂ 4.5–5.6, ♀ 5.5–6.3. Pronotum width, ♂ 7.0–8.4, ♀ 8.5–9.8. Pronotum length, ♂ 29–32, ♀ 42–44. Fore coxa length, ♂ 17–18, ♀ 22–23. Fore femur length, ♂ 19–21, ♀ 27–29. Tegmen length, ♂ 50–52, ♀ 40–44. Cercus length, ♂ 8.7–10.0, ♀ 10.5–13.0.

Immature stages. Nymphs with pale mid dorsal abdominal stripe but not as prominent as some other members of the genus. Ootheca unknown.

Distribution and habits. Found across the tropical north of Australia (fig.172). I have collected later instars of this species in shrubs and early instar nymphs in low shrubs and grasses in open woodland, in northern Queensland.

Remarks. It is possible that this species may be conspecific with *A. armata* as the amount of variation between the two species is no greater than that found in several other species in this genus. However at present all specimens examined can be assigned to one or other species. Further collecting in the area between Charters Towers and Mount Surprise in Queensland should clarify this situation.

Archimantis quinquelobata (Tepper)

Figures 111–125, 169

Fischeria quinquelobata Tepper, 1905: 238.

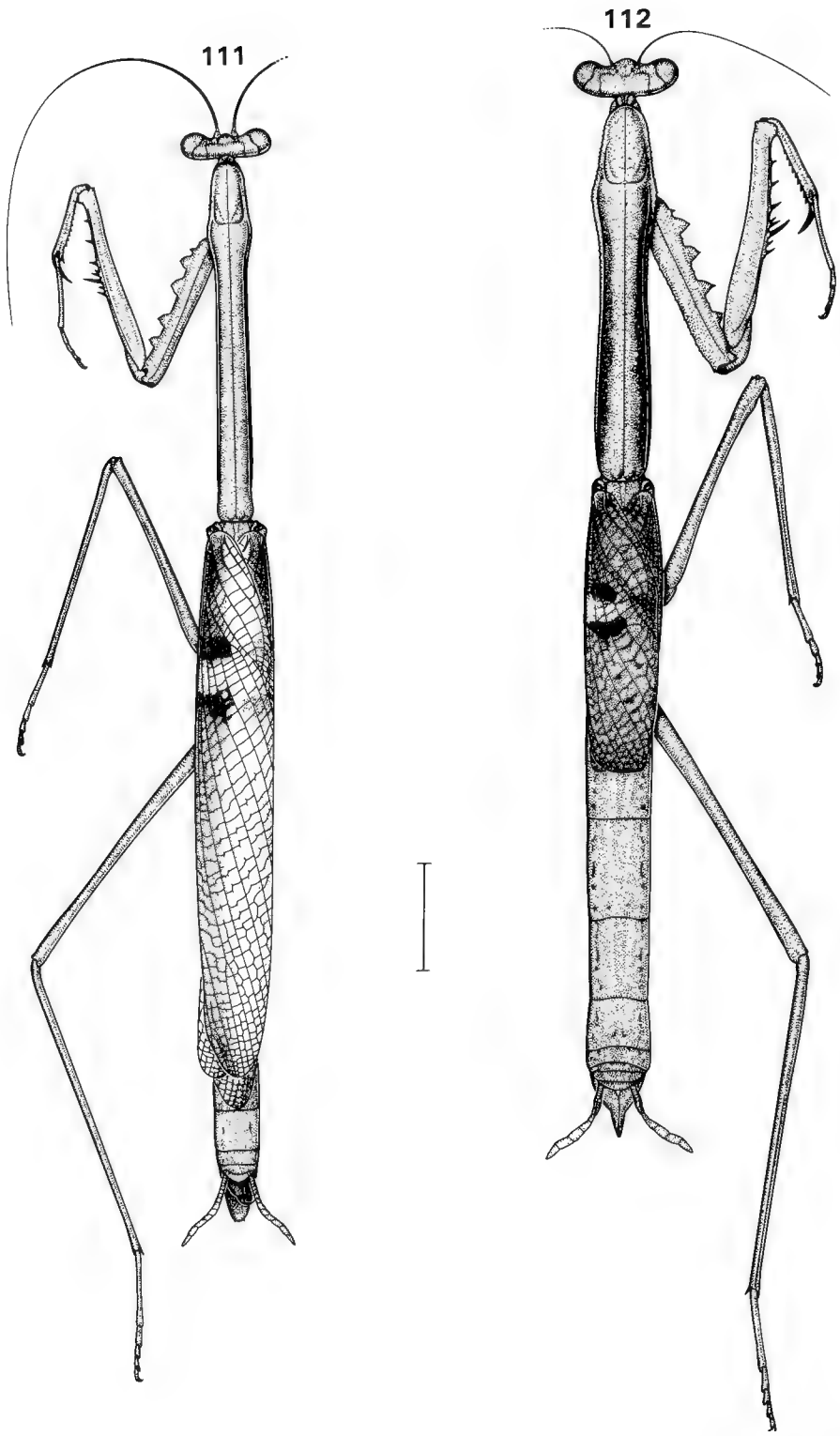
Rheomantis quinquelobata (Tepper)-Giglio-Tos, 1917: 44.

Archimantis quinquelobata (Tepper)-Tindale, 1923: 441.

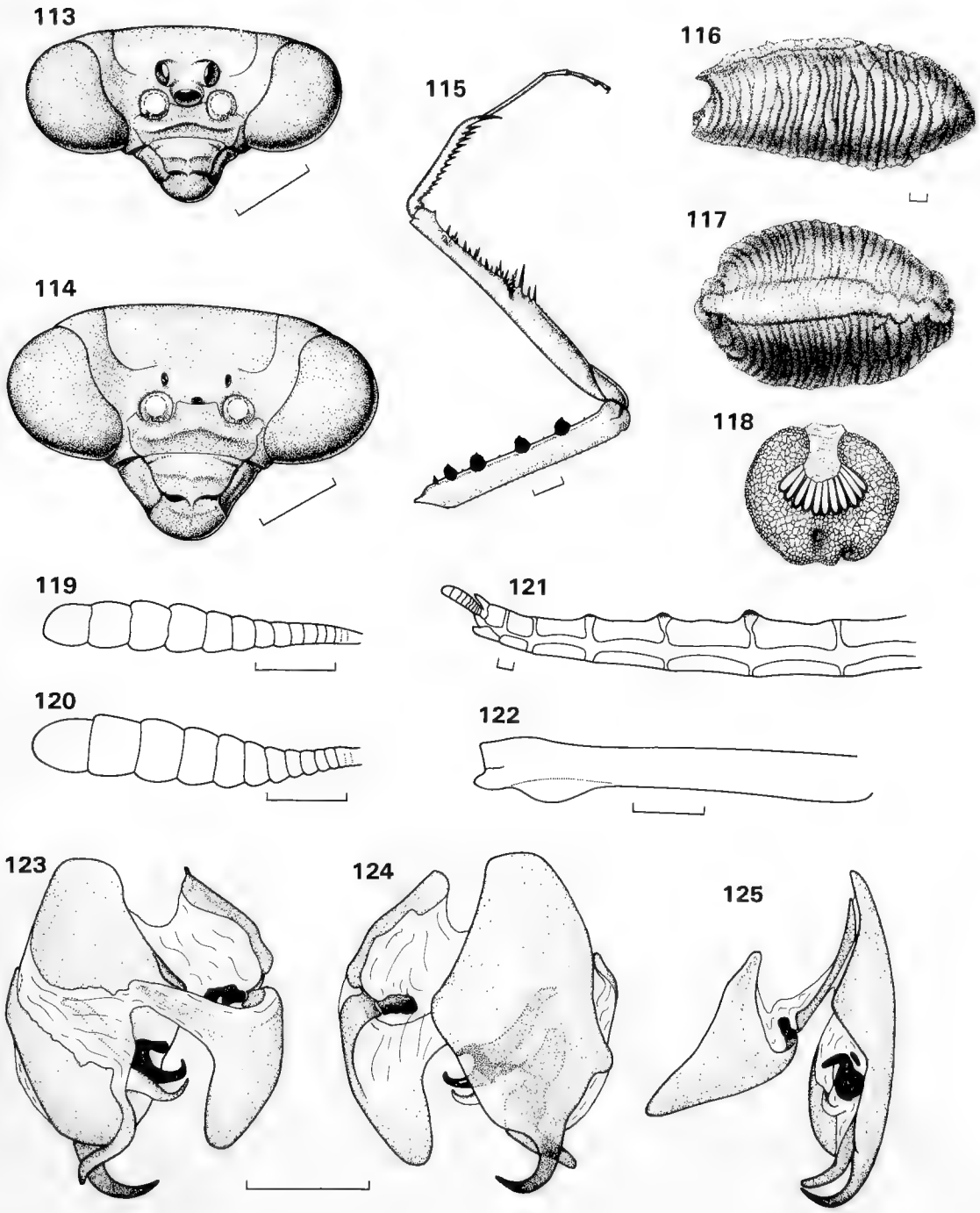
Material examined. Syntype female of *A. quinquelobata*, Yactoo, South Australia, 19 May 1887, M.Crawford. Syntype female of *A. quinquelobata*, north west South Australia, Mar-Dec 1903, H.Basedow, I 14067. Syntype female of *A. quinquelobata*, Broken Hill (NSW), 3 Jan 1890, F.J.Burgess (all SAM). See Balderson (1984) for discussion of type material.

Other specimens examined (49♂, 50♀, 33 juv.). Qld. ♂, 26°24′S, 146°15′E, Charleville, 7 Apr 1976. ♂, 21°41′S, 140°30′E, Selwyn Mine, 160 km SE of Mt Isa. 16 Oct 1990 (both ANIC). 2 juv., 25°48′S, 146°35′E, Augathella, 18 Jan 1993. ♀, Charleville, 15 Mar 1921. ♀, 21°13′S, 146°29′E, 140 km S of Charters Towers, 19 Feb 1989. 1 juv., 25°40′S, 146°30′E, Khyber Rd., 14 km N of Augathella, 18 Jan 1993 (all NMV). ♀, Cunnumulla (SAM).

NSW. ♂, Bogan River, 40 km E of Coolabah, 8 Jan 1963. ♀, 23 km NNE of Bourke, 13 Mar 1959. 3♂, 18 km WNW of Bourke, 9 Jan 1972. 1 juv., 47 km N of Bourke, 23 Dec 1961. ♀, 30°50′S, 146°33′E, 23 km SSE of Byrock, 5 Apr 1976. ♂, 7 km W of Cobar, 20 Feb 1963. ♀, 6 km W of Cobar, 23 Mar 1972. 1 juv., 6 km W of Cobar, 10 Dec 1971. 1 juv., 7 km W of Cobar, 1 Feb 1964. 1 juv., 25 km SW of Dubbo, 16 Jan 1961. 1 juv., 20 km N of Dubbo, 19 Jan 1961. 1 juv., 12 km SE of Girilambone, 23 Dec 1961. 1 juv., 12 km NW of Goolma, 14–15 Jan 1961. 1 juv., 8 km W of Mendooran, 18 Jan 1961. 1 juv., 5 km SE of Merrygoen, 18 Jan



Figures 111–112, *Archimantis quinquelobata*. 111, male; 112, female. Scale = 10 mm.



Figures 113–125, *Archimantis quinquelobata*. 113, male head; 114, female head; 115, male foreleg, inside; 116, ootheca, lateral; 117, ootheca, dorsal; 118, ootheca, transverse; 119, male cercus; 120, female cercus; 121, mid instar nymph, abdomen lateral; 122, mid instar nymph, mid left femur, dorsal; 123, male genitalia, dorsal; 124, male genitalia, ventral; 125, male genitalia, right lateral. Scale = 2 mm.

1961. ♀, Trangie, 6 Apr 1956. (all ANIC). 6♂, 7♀, 22 km NNW of Coombah, 29 Jan 1990 (NMV). 2♂, Broken Hill, 11 Dec 1906. ♀, Carinda, nr Orange, Mar 1928. 1 juv., 32 km W of Euabalong, 28 Jan 1969. ♀, Menindee Lakes, 16 May 1969 (all SAM).

NT. ♂, 23°41′S, 134°15′E, 39 km E of Alice Springs, 25–26 Sep 1978. ♂, 23°41′S, 133°52′E, Alice Springs, 3–4 Nov 1988. ♂, Ayers Rock, 7 Nov 1980. ♂, Ayers Rock, 16 Feb 1967. 1 juv., 12 km SE of Frewena, 23 Aug 1960. ♂, 23°48′S, 132°21′E, 5 km NE of Gosses Bluff, 10 May 1969. ♀, 37 km NNW of Renner Springs, 24 Mar 1955. ♀, 20°53′S, 130°25′E, Sangsters Lake, 38 km SE of The Granites Mine, Tanami Desert, 31 Oct 1988. ♂, 25°21′S, 131°03′E, Uluru Motel, Ayers Rock, 6 Nov 1980 (all ANIC). ♂, 55 km NNW of Alice Springs, 27 Sep 1987. 2♀, 20°52′S, 130°16′E, 10 km WSW of Sangsters Bore, SE of The Granites, Tanami Desert, 27–31 Oct 1987 (all NMV). ♀, Alice Springs, Jun 1894. 1 juv., Palm Creek (both SAM).

SA. ♀, Marte, 6 Feb 1888 (AM). ♂, 26°09′S, 130°35′E, 56 km W of Amata, Musgrave Ranges, 19 Jan 1982. ♂, 5 km ESE of Bopeechee, 1 Jan 1969. 1 juv., 31°17′S, 131°34′E, 27 km E of Ivy Tank Motel, 31 Oct 1970. 1 juv., Leigh Creek, 29 Sep 1965. 1 juv., Wilpena Pound, 25 Feb 1970 (all ANIC). ♀, Overland Railway, 17 km E of Golden Well, Jan-Mar 1909. 1 juv., 31 km NW of William Creek, 18 Sep 1987 (both NMV). 1 juv., Cortina Stn. ♂, Kingoonya. 1 juv., 26°04′S, 135°05′E, Lake Suprise, Simpson Desert. ♂, Macumba Creek, 22 Nov 1909. 6♂, Mt Painter, Flinders Range. ♂, Murray River. ♀, Ooldea. ♀, north South Australia, 18 Feb 1888. ♂, Tintara. ♀, Wynbring (all SAM).

Vic. ♀, 24 km NNE of Bendigo, 3 Jan 1987. 3♀, Hattah Lakes Nat Pk, 10 Apr 1982. 2♂, 4♀, Hattah Lakes Nat Pk, 8 Apr 1982. ♀, nr Murray River. 1 juv., 35°32′S, 14229′, Waithe Reserve, 21 Jan 1987 (all NMV).

WA Australia. ♂, Balgo Hills, 19 Oct 1985. ♂, Brogo Hill, 160 km S of Halls Creek, 14 Oct 1985. 1 juv., 27 km ENE of Cosmo Newbery Mission, 14 Oct 1970. ♀, 27°50′S, 114°43′E, Four Mile Pool, Murchison River, 23 Oct 1984. 1 juv., Gahnda Rockhole, 1–2 Feb 1967. ♂, 11 km N of Geraldton, 26 Jan 1973. ♂, 29°36′S, 115°15′E, Gravel Scrape, 25 km N of Eneabba, 24 Oct 1984. ♂, 6 km W of Hayes Hill, nr Lake Cowan, 8 Feb 1983. ♂, 30°09′S, 115°07′E, 19 km NNE of Jurien, 25 Oct 1984. 1 juv., 5 km NNW of Kalgoorlie, 11 Feb 1975. 3 juv., 27°34′S, 14°26′E, Loop Rd, 30 km ENE of Kalbarri, Kalbarri Nat Pk, 17 Oct 1984. ♂, ♂, 18 km E of Meekatharra, 28 Apr 1963. 1 juv., 10 km W of Mia Mia HS, nr Exmouth Gulf, 29 Jan 1972. 3♂, Mt Leonora, nr Leonora, 13 Feb 1981. 2 juv., Mt Leonora, nr Leonora, 20 Feb 1979. 1 juv., 26°31′S, 119°53′E, 4 km ESE of Mt Russell, NW of Wiluna, 15 Oct 1984. ♂, 85 km ENE of Port Hedland, 18 Apr 1963. ♂, 60 km SE of Sandstone, 23 Jan 1973. ♂, 1.5 km SE of Spargoville, 10 Feb 1980. ♀, 3 km NW of Spargoville, 17 Feb 1982. 1 juv., 28°32′S, 121°00′E, Victory Creek, 50 km NNW of Leonora, 14 Oct 1984. 1 juv., 21°58′S, 118°03′E, 42 km NW of Wittenoom, 11 Nov 1970. ♀, 48 km ESE of Wittenoom, 25 Apr 1963. 1 juv., 28°26′S, 116°05′E, 20 km W of Wurarga, NE of Mullewa, 16 Oct 1984 (all ANIC). 1 juv., Middalya, 17 Aug 1904 (NMV). ♀, Coolgardie, 1 May 1896. 2♀, Fraser Range, Oct 1891 (all SAM). ♀, 27°42′S, 121°37′E, 7.5 km SE of Banjiwarn Stn, 22–28 Feb 1980. ♀, 31°12′S, 120°17′E, Boorabbin Rock, 20–21 Jan 1982. ♀, Charles Knob, 500 km NE of Laverton, 20 Feb 1964. ♀, 29°57′S, 121°07′E, 3.8 km NE of Comet Vale Siding, 7–15 Mar 1979. ♂, Mt Egerton. ♀, Lake Side. ♀, Landor Stn. ♀, Narrogin. ♀, Tardun, 1 Jan 1963. ♂, Towrana Stn (all WAM).

Diagnosis. Lateral margin of eyes rounded, lateral margins of pronotum with only very fine denticles in anterior part, anterior margin of fore coxa with four large and one or two smaller teeth which are black on inner face, tegmina of female covering first 2½ abdominal tergites, apical segment of cercus with rounded margin; pa of male genitalia with two lateral projections, the anterior one short and flattened, the lower one elongate unciform.

Description. Body of male slender, of female more robust, considerable variation in size; colour grey to brownish, sometimes with lighter and darker mottlings. Apical margin of head slightly arched; eyes anteriorly protuberent, with rounded lateral margins; frontal shield with distinct subantennal ridge. Prothorax moderately to extremely elongate, slight but distinct supracoxal expansion; lateral margins very finely tuberculate in prozona and smooth in metazona of male, more strongly tuberculate in prozona and finely tuberculate in anterior half of metazona of female; prozona with few small scattered tubercles above, stronger tubercles below that are cream coloured surrounded by dark background; metazona with distinct mid dorsal carina, reddish black ventrally between bases of fore coxae. Fore coxa (fig. 115) with four large flat triangular teeth and usually smaller proximal one, occasionally small distal one, these teeth coloured black ventrally and contrasting with pale colouration of rest of inner face of coxa. Fore femur with all spines tipped blackish brown. Fore femur with 13–15 inner and 9–10 outer spines, all tipped blackish brown. Mid and hind femora with or without genicular spine. Tegmina of male covering first six abdominal tergites; costal area opaque brownish above, darker orange brown beneath in proximal fifth with remainder pale semi opaque; anterior third of discoidal area opaque brownish above and darker orange brown beneath with large dark spot at proximal end and smaller dark spot at distal end of stigma dorsally, remainder hyaline, venation slightly to distinctly dark coloured. Hind wing of male with distal two thirds of

costal area and apical portion of discoidal area brownish with veins darker, remainder hyaline. Tegmina of female covering first 2½ abdominal tergites; costal and discoidal areas opaque brownish or grey above, reddish brown beneath, often with scattered semi opaque areas in discoidal area; dark patches at ends of stigma extensive, sometimes joining posteriorly, stigma paler than surrounding area; venation more darkly coloured. Hindwing of female very reduced, only about half the length of tegmin; smokey blackish brown in costal area and anterior portion of discoidal area, particularly apically, more orange brown beneath, remainder hyaline. Abdomen without pale mid dorsal stripe, anterior margin of sternites 3–6 blackish, posterior margin of sternites 2–5 with fine creamy yellow border; cerci (figs 119–120) slightly to distinctly elongate, margin of apical segment rounded. Male genitalia (figs 123–125) with dps of vph strongly curved, narrow at base and gradually narrowing to point distally; anterior portion of vl of lph narrow, slightly produced at junction with pa; apr swollen proximally, tip simple; pa finely shagreened with narrow projection at junction with vl and two prominent projections dextrad, anterior one short and slightly flattened to spatulate with distal margin finely serrate, posterior one longer and spiniform, directed laterally then curving ventrally; small sclerite in membrane anterior to pa.

Measurements (mm). Body length, ♂ 80–103, ♀ 77–132. Head width, ♂ 7.2–8.2, ♀ 8.0–11.4. Head depth, ♂ 4.3–4.6, ♀ 5.0–7.4. Pronotum length, ♂ 23–34, ♀ 27–47. Pronotum width, ♂ 3.7–4.1, ♀ 5.4–6.5. Fore coxa length, ♂ 14–16, ♀ 15–24. Fore femur length, ♂ 16–18, ♀ 18–27. Tegmen length, ♂ 48–52, ♀ 20–35. Cercus length, ♂ 4.5–9.0, ♀ 3.9–10.0.

Immature stages. Nymphs often display a small lobiform expansion apically on posterior edge of mid and hind femora (fig. 122) and single, small bulbous dorsal protrusions between abdominal tergites 3–6 (fig. 121). Ootheca (figs 116–118) rather depressed oblong with fairly thick spongy layer, cells arranged in a shallow u-shaped formation, colour pale grey, brown or greenish, deposited near ground on shrubs, grasses, logs or rocks, when on flat surfaces rather depressed in appearance, often parasitised by wasps of the genus *Podagrion*.

Distribution and habits. Recorded from the more arid regions of mainland Australia (fig. 169). Usually found in woody shrubs though occasionally in tall grasses. Adults most commonly collected from January to April.

Archimantis brunneriana Saussure

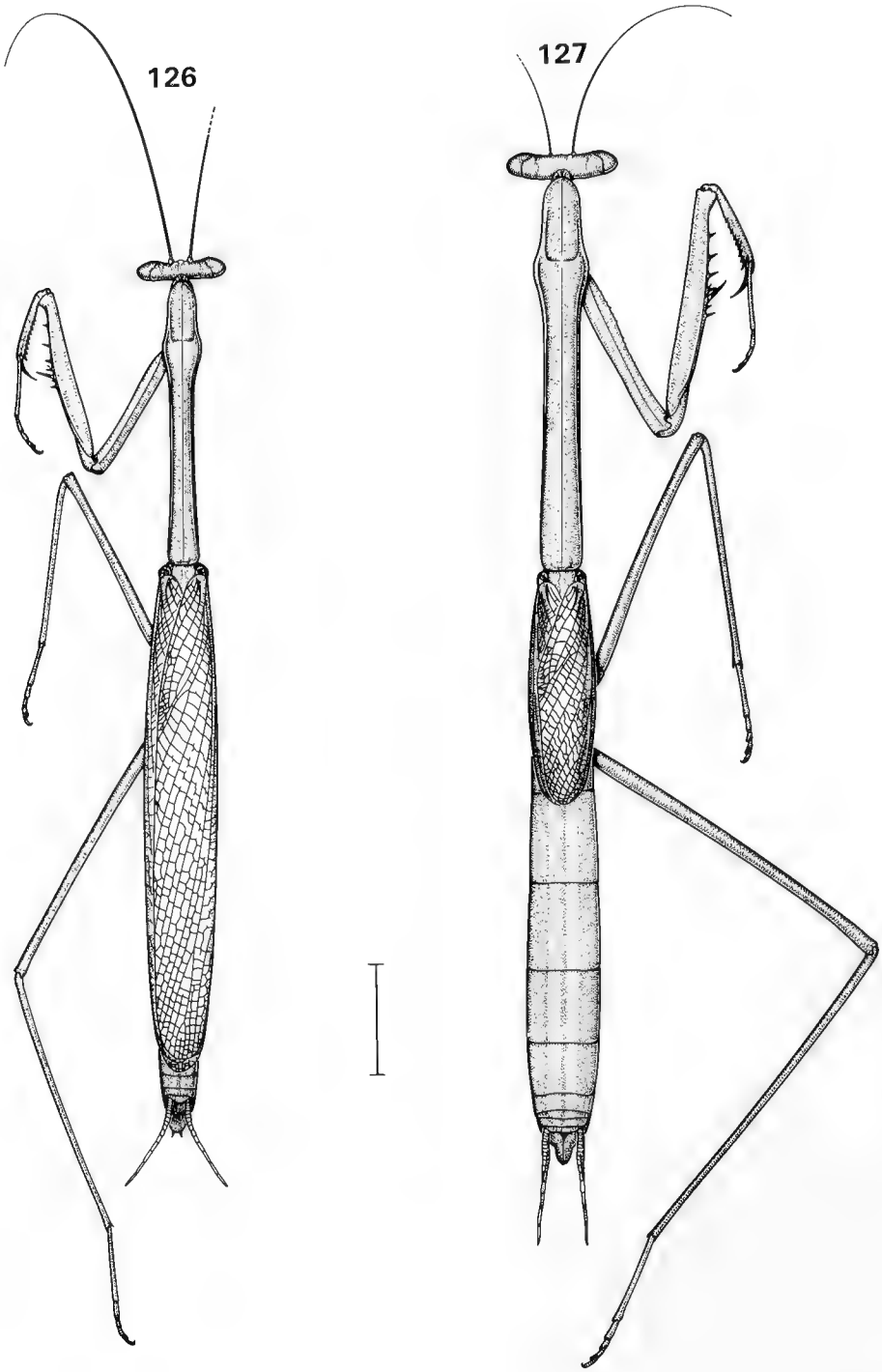
Figures 126–136, 173

Archimantis brunneriana Saussure, 1871: 277.

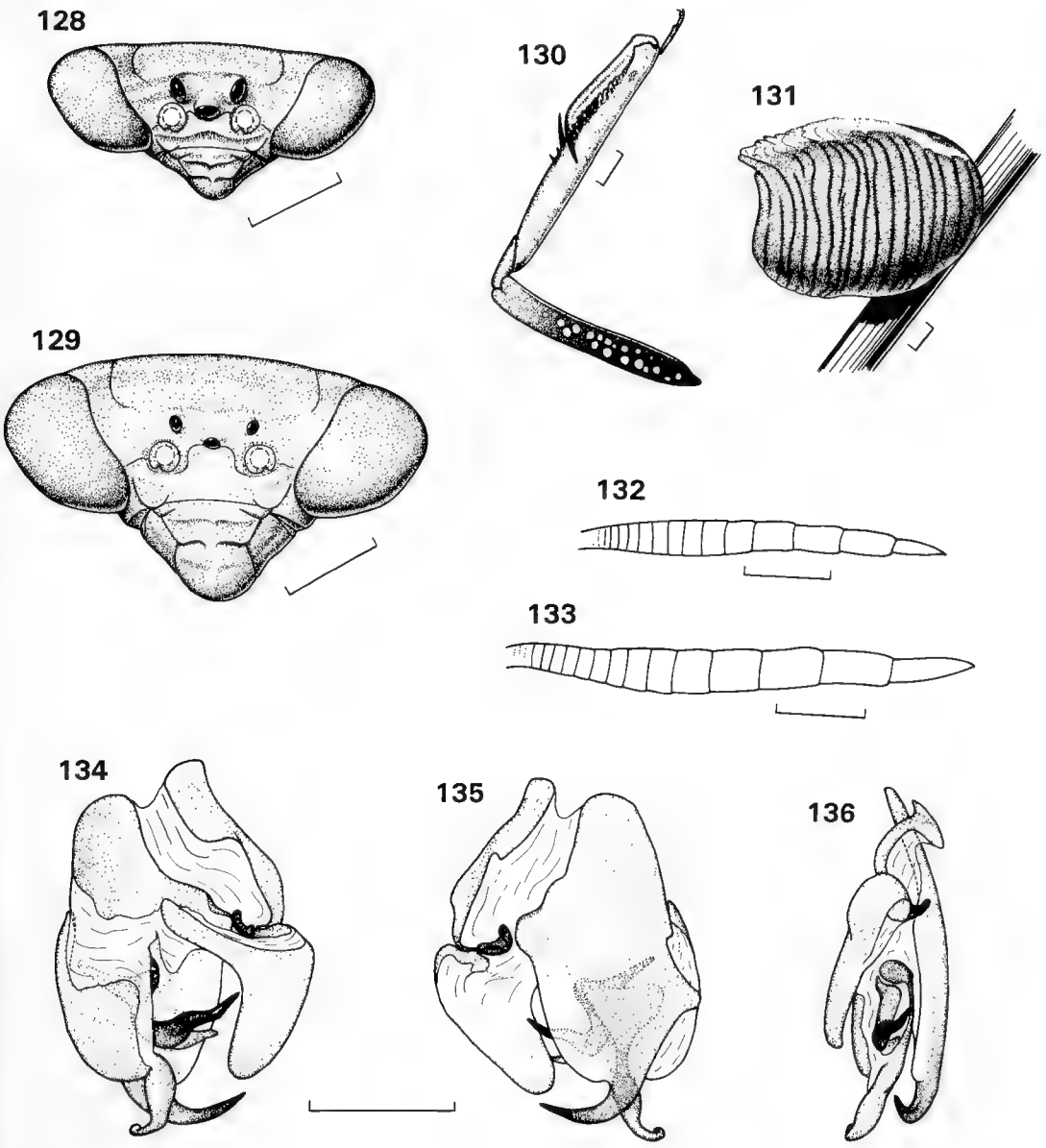
Material examined (10♂, 8♀, 10 juv.). Qld, ♂, Kinbombi Falls, nr Goomeri, 19 Dec 1976. ♂, 20 km N of Monto, 6 Dec 1979 (both AM). ♂, Armstrong Creek Crossing, 13 km NNW of Guthalungra, 26 Jan 1982. 1 juv., 3 km N of Bundaberg, 23–30 Jun 1971. ♂, Burnett River Crossing, 10 km NE of Eidsvold, 9 Jan 1970. ♂, ♀, Ceratodus, 31 Dec 1955. ♂, 17°12′S, 144°34′E, 6 km SE of Chillagoe, 26 Nov 1981. 1 juv., 13°56′S, 143°12′E, Coen, 18 Jul 1986. ♂, 2 juv., 1.7 km W of Gayndah, 3 Jan 1965. 1 juv., 23°20′S, 150°35′E, Mt Archer (NW summit), Rockhampton, 30 Jun 1980. ♂, Mt Garnet, Dec 1960. 1 juv., 25°26′S, 152°56′E, Mt Tibrogargan, Glasshouse Mountains, 15 Aug 1985. ♀, 10 km NE of Stanwell, 6 Jan 1965. ♀, Tannum Beach, nr Gladstone, 22–23 Dec 1955. 1 juv., Watalgan Range, nr Bundaberg, 6 Nov 1971. ♀, 20°10′S, 152°33′E, Woodgate Nat Pk, 29 km ENE of Childers, 13 Aug 1985 (all ANIC). 1 juv., Bruce Hwy, 4 km S of Bowen, 1 Apr 1991. ♂, 12°44′S, 143°16′E, Claudie River, Iron Range Nat Pk, 25 km NW of Lockhart River, 10 Nov 1988. ♂, 8 km E of Emuford, 30 Dec 1989. 3♀, 16°48′S, 145°22′E, 22 km NNW of Mareeba, 15 Feb 1989. 2 juv., 44 km SSW of Mundubbera, 31 Mar 1991 (all NMV). ♀, Brisbane (QM).

Diagnosis. Lateral margin of eye angular, lateral margin of pronotum without teeth, anterior margin of fore coxa without large teeth, inner face of fore coxa with pattern of small pale spots on blackish background that peters out distally, tegmina of female covering first two abdominal tergites, apical segment of cercus with pointed apex, pa of male genitalia with tip of projection directed laterally and slightly anteriorly.

Description. Body slender, grey-brown, brown, yellow-brown or pale green in colour. Head strongly anterio-posteriorly compressed, apical margin broadly arched in female, almost horizontal in male; frontal shield with distinct subantennal ridge in male, only very slight ridge in female; eyes with angular lateral margins. Prothorax slender with slight but distinct supra coxal expansion; lateral margins entire in male, minutely denticulate for whole length in female but sparser posteriorly; prozona sparsely granulate above, more densely tuberculate below; metazona with distinct mid dorsal carina, darkly coloured ventrally between bases of fore coxae. Fore coxa (fig. 130) with few very small blunt teeth on anterior edge in male, more numerous in female with 2 or 3 larger ones proximally;



Figures 126–127, *Archimantis brunneriana*. 126, male; 127, female. Scale = 10 mm.



Figures 128–136, *Archimantis brunneriana*. 128, male head; 129, female head; 130, male foreleg, inside; 131, ootheca, lateral; 132, male cercus; 133, female cercus; 134, male genitalia, dorsal; 135, male genitalia, ventral; 136, male genitalia, right lateral. Scale = 2 mm.

inner face dark brown, becoming black proximally with numerous irregular pale spots. Fore femur with all spines tipped black-brown, claw groove slightly distal of mid point. Fore tibia with 15–16 inner and 9–11 outer spines, all more or less tipped black. Inner face of tarsal segments sometimes blackish. Mid and hind femora without genicular spine. Wings of male reaching just beyond fifth abdominal tergite; tegmen with costal area opaque white except for posterior proximal third which is black, costal margin of discoidal area orange-brown, colours more intense below, remainder of tegmen hyaline. Tegmina of female reaching just beyond caudal margin of second abdominal tergite; colouring similar to male except that pale costal margin very narrow, black colour extends for three quarters of the length of costal area and orange-brown band broader, covering about one third of discoidal area. Hindwings of both sexes with costal and sub costal areas orange-brown, remainder hyaline. Abdomen sometimes with broad pale median dorsal stripe, anterior margin of sternites 3–7 blackish; apical segment of cercus (figs 132–133) with pointed apex. Male genitalia (figs 134–136) with dpr of vph narrow at base, strongly curved; anterior section of vl of lph broadly triangular, broad projection at junction with pa; apr with medial bulge, distal end short, tip slightly mucronate; pa with single uncinate spiniform projection, lightly shagreened, slightly sinusoidal distad with sharp angle near tip.

Measurements (mm). Body length, ♂ 72–78, ♀ 86–92. Head width, ♂ 6.5–7.3, ♀ 8.4–9.0. Head depth, ♂ 3.1–3.6, ♀ 4.8–5.1. Pronotum length, ♂ 23–26, ♀ 32–35. Pronotum width, ♂ 2.9–3.4, ♀ 4.3–4.8. Fore coxa length, ♂ 13, ♀ 16–19. Fore femur length, ♂ 15, ♀ 19–21. Tegmen length, ♂ 36–37, ♀ 20–22. Cercus length, ♂ 8.2–8.4, ♀ 10.9–12.4.

Immature stages. Nymphs similar in colour to adults; ootheca (fig. 131) rather small, brownish, thin spongy layer, eggs in w-formation, deposited on stems of shrubs and grasses.

Distribution and habits. Recorded from eastern Queensland, from Iron Range in the north to Brisbane in the south (fig. 173). Found in grasses and shrubs in woodland habitats.

Archimantis straminea Sjöstedt

Figures 137–147, 173

Archimantis straminea Sjöstedt, 1918: 17.

Material examined. Lectotype ♂, here designated, Noonkanbah, NW Austr., Dec, Mjöberg, (3) 271 82. Paralectotype ♀, here designated, NW Austr., Mjöberg, (3) 272 82 (both NHRM).

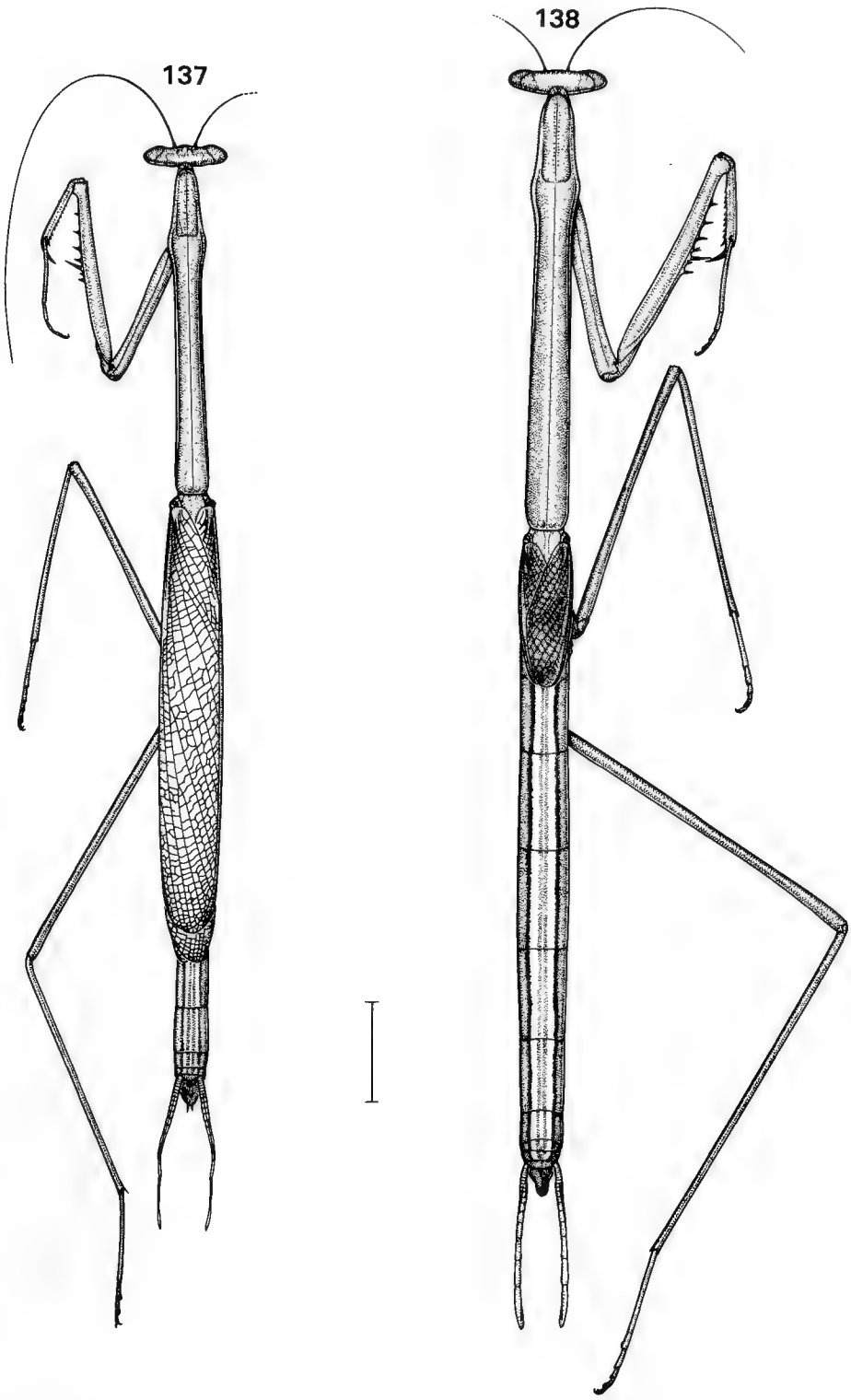
Other specimens examined (20♂, 6♀, 21 juv.). Qld. ♂, Butcher Creek, 20 km W of Cloncurry, 21 Jan 1977. ♂, 65 km E of Hughenden, 3 Feb 1981 (both AM). 3 juv., 8 km E of Dunbar HS, 10 Oct 1965. ♀, 25 km SE of Mt Christison, Hughenden dist., 10–11 Jan 1965. 1 juv., 8 km ENE of Prairie, 10 Jan 1965 (all ANIC). ♂, ♀, 19°14′S, 140°21′E, Burke and Wills Junction, 16 Jan 1993. ♀, 17°33′S, 141°09′E, Eleven Mile Ck., 16 km NNE of Normanton, 10 Jan 1993. 4♂, ♀, 1 juv., 17°33′S, 141°09′E, Eleven Mile Ck., 16 km NNE of Normanton, 5 Jan 1993. 1 juv., 6 km NE of Georgetown, 15 Apr 1991. ♂, ♀, 1 juv., 12 km E of Georgetown, 12 Apr 1991. 2♂, 17°51′S, 141°08′E, Glenore Pumping Station, Norman River, 13 Jan 1993. 1 juv., 17°38′S, 141°09′E, 9 km NE of Normanton, 4 Jan 1993. 3♂, 1 juv., 17°36′S, 141°09′E, 11 km NE of Normanton, 6 Jan 1993 (all NMV). ♂, Cloncurry, 8 Apr 1947 (UQ).

NT. ♂, Alpha Creek, 35 km W of Timber Creek township, 8 Jan 1986. 1 juv., 16°08′S, 136°06′E, 22 km WSW of Borroloola, 2 Nov 1975. 1 juv., 17 km S of Dunmarra, 4 Nov 1965. ♂, Keep River Crossing, Victoria Hwy, 7 Jan 1986. 1 juv., 25 km NNW of Larrimah, 20 Nov 1966. 1 juv., 10 km NW of Larrimah, 4 Nov 1965. 1 juv., 30 km NW of Mataranka, 17 Aug 1960. 3♂, October Creek, Carpentaria Hwy, 180 km E of Daly Waters, 11 Jan 1986. ♂, 11°01′S, 136°45′E, Rimbija Island, Wessel Is, 12 Feb 1977. 1 juv., 35 km E of Timber Creek, 29 Oct 1965. ♂, Tindal, 6 Dec 1967. ♀, 16 km W of West Barnes River Crossing, Victoria Hwy, 8 Jan 1986 (all ANIC).

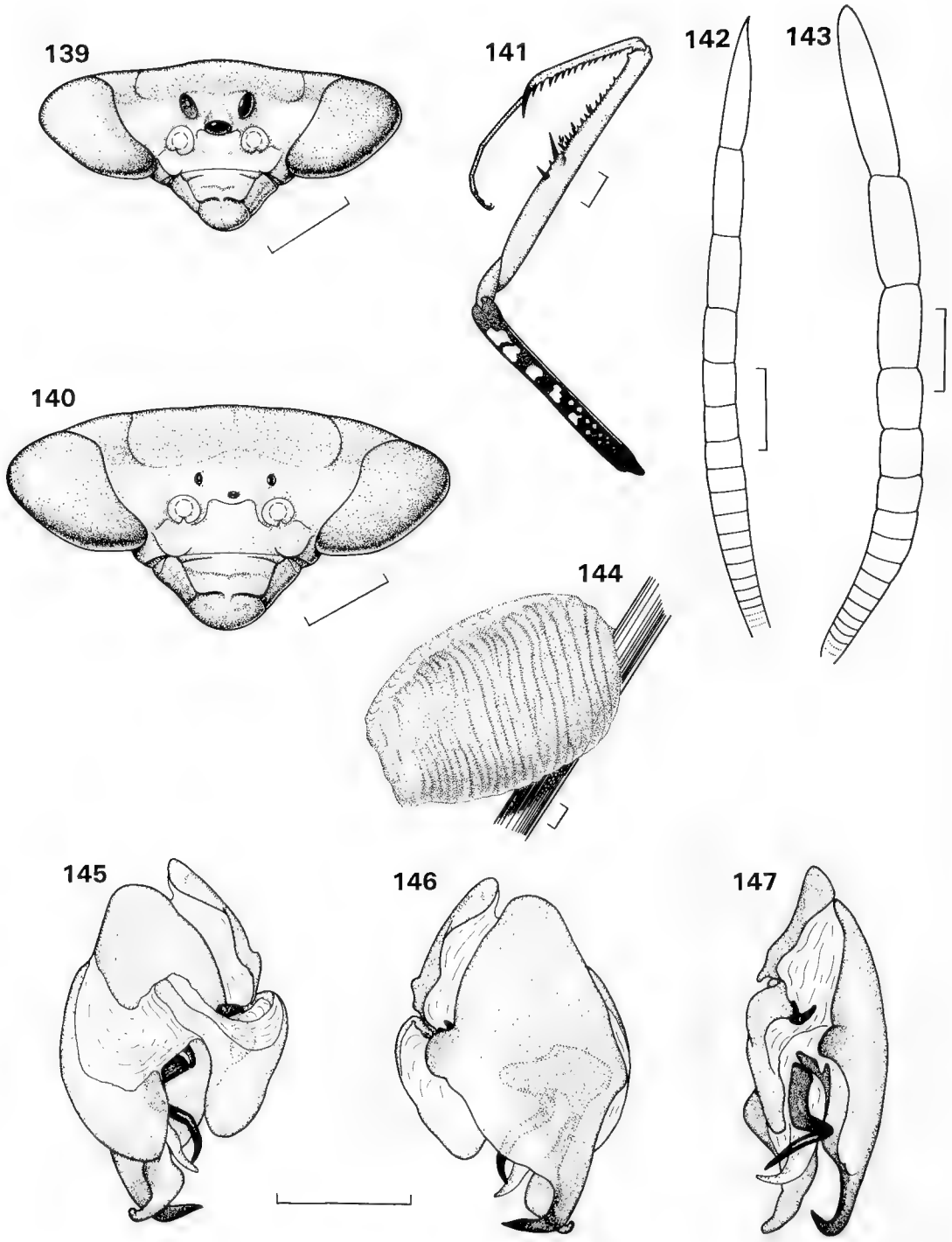
WA. 1 juv., 18°22′S, 122°53′E, 85 km ESE of Broome, 16 Aug 1976. 1 juv., 18 km E of Gibb River HS, Kimberley dist., 21 Jun 1979. 1 juv., 14°13′S, 126°44′E, 13 km NE of Kalumburu, 17 Jun 1985. 2♂, Lissadel Stn, nr Kununurra, Feb 1982. 1 juv., McSpeery Gap, Napier Range, SE of Kimberley Downs HS, 27 Oct 1969. 1 juv., Wyndham East, 27 Oct 1965 (all ANIC).

Diagnosis. Lateral margin of eye distinctly angular, lateral margin of pronotum without teeth, anterior margin of fore coxa without large teeth, inner face of fore coxa with pattern of large pale spots on blackish background which extends distally, tegmina of female covering only first abdominal tergite, apical segment of cercus with pointed apex, pa of male genitalia directed laterally then caudally.

Description. Body moderately large, elongate and slender; pale brown, yellow brown or green in colour. Head strongly anterio-posteriorly compressed, apical margin only slightly arched, eyes with lateral margins distinctly angled, frontal shield lacking subantennal ridge. Prothorax elongate and slender with slight but distinct



Figures 137–138, *Archimantis straminea*. 137, male; 138, female. Scale = 10 mm



Figures 139–147, *Archimantis straminea*. 139, male head; 140, female head; 141, male foreleg, inside; 142, male cercus; 143, female cercus; 144, ootheca, lateral; 145, male genitalia, dorsal; 146, male genitalia, ventral; 147, male genitalia, right lateral. Scale = 2 mm.

supracoxal expansion; lateral margins entire in male , virtually so in female; prozona sparsely granulate above, more densely tuberculate below; metazona with distinct mid dorsal keel, darkly coloured between bases of fore coxae. Fore coxa (fig. 141) with numerous small tubercles on anterior edge; inner face dark brown to blackish with pale spots which become larger distally. Fore femur with all spines tipped blackish brown, claw groove slightly distal of mid point. Fore tibia with 14–16 inner and 10–11 outer spines, all tipped blackish. Mid and hind femora without genicular spine. Wings of male reaching just beyond fifth abdominal tergite; tegmen with costal area opaque white except for proximal third which has posterior black band, costal margin of discoidal area orange-brown, colours more intense beneath, remainder hyaline. Tegmina of female only covering first abdominal tergite; colour of costal area similar to male except inner black band broader, extending almost to apex; discoidal area completely opaque, pale pinkish above, intense rose colour below. Hindwings of both sexes with costal area orange-brown, remainder hyaline, those of female very reduced. Abdomen with broad, pale mid dorsal stripe, anterior margin of sternites 3–7 red and blackish; cerci (figs 142–143) very elongate, apical segment with pointed apex. Male genitalia (figs 145–147) with dpr narrow at base, with abrupt curve at mid point; anterior section of vl of lph broad with rounded margins; apr with medial bulge, distal end short, tip slightly mucronate; pa with single, long spiniform projection, directed caudally, laterally then dorso-caudally.

Measurements (mm). Body length, ♂ 78–91, ♀ 100–108. Head width, ♂ 8.5–9.0, ♀ 10.0–10.8. Head depth, ♂ 4.0–5.0, ♀ 5.0–5.5. Pronotum length, ♂ 28.0–31.5, ♀ 39.0–42.0. Pronotum width, ♂ 3.8–4.0, ♀ 4.5–4.8. Fore coxa length, ♂ 13.8–15.5, ♀ 18.5–19.5. Fore femur length, ♂ 15.5–18.0, ♀ 21.5–23.0. Tegmen length, ♂ 38.0–41.0, ♀ 14.0–14.5. Cercus length, ♂ 12.0–15.4, ♀ 16.5–18.5.

Immature stages. Nymphs similar in appearence to adults. Ootheca (fig. 144) similar in appearance to that of *A.brunneriana* but pale greenish in colour with a slightly thicker spongy layer.

Distribution and habits. Found across the tropical north of Australia, west of the Dividing Range (fig. 173). I have collected this species in long grasses in open woodland country in north Queensland.

Archimantis gracilis sp. nov.

Figures 148–157, 174

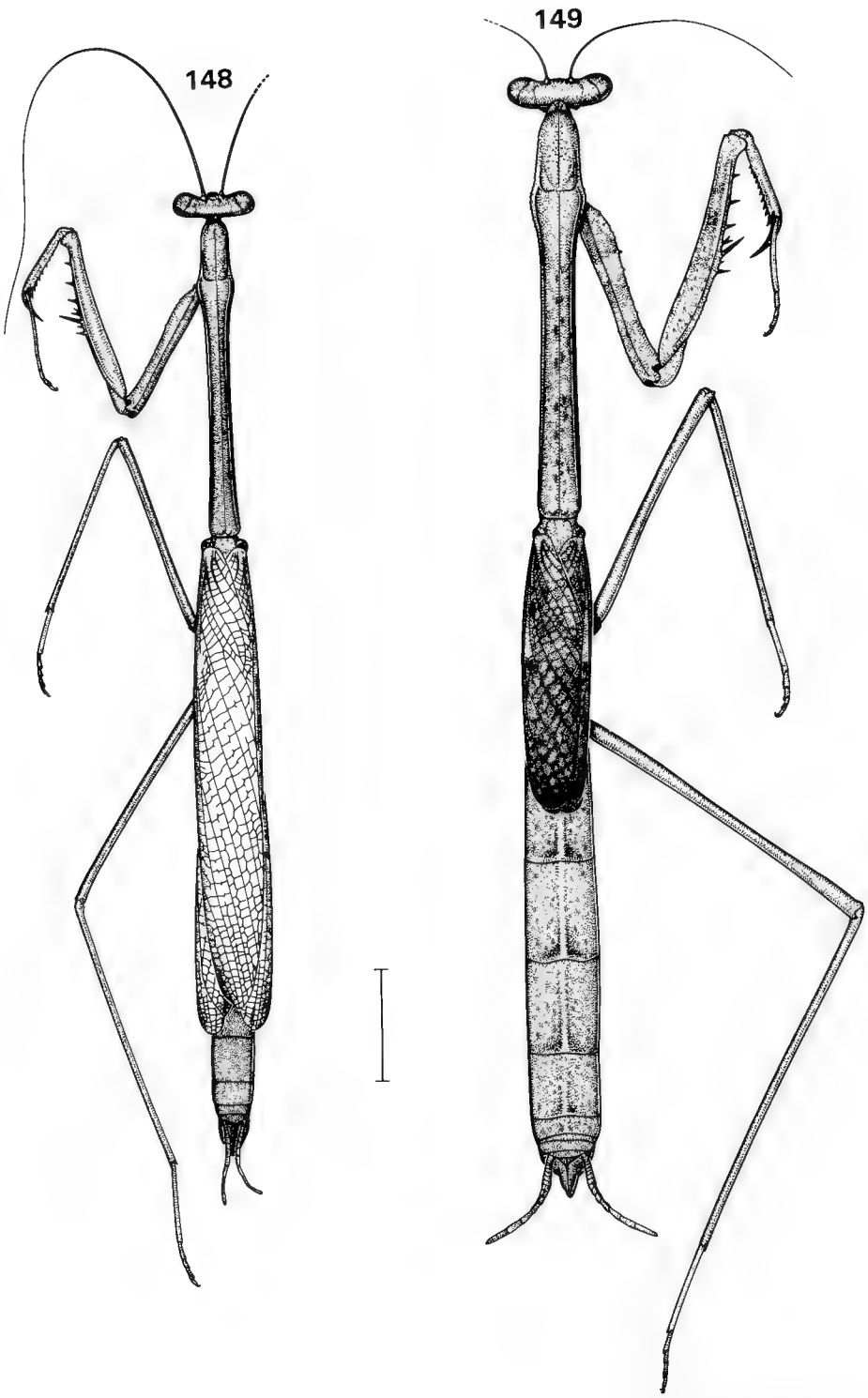
Material examined (7♂, 4♀, 5 juv.). Holotype: ♂, 12°50′S, 132°51′E, 16 km E of Mt Cahill, Northern Territory, 7 Mar 1973, K.H.L.Key (ANIC).

Paratypes. NT. ♂, 2♀, 12°25′S, 132°58′E, 1 km N of Cahills Crossing, East Alligator River, 30 May 1973, K.H.L.Key. ♀, 5 km NNW of Cahills Crossing, East Alligator River, 25 May 1973, K.H.L.Key. ♀, 12°25′S, 132°58′E, 1 km N of Cahills Crossing, East Alligator River, 29 May 1973, K.H.L.Key. ♂, 12°31′S, 132°54′E, 9 km NE of Mudginbarry HS, 10 May 1973, M.S.Upton & J.E.Feehan. ♂, 12°17′S, 133°14′E, 15 km WSW of Nimbuwah Rock, 1 Jun 1973, K.H.L.Key. 3♂, 12°22′S, 133°01′E, 6 km WSW of Oenpelli, 30 May 1973, K.H.L.Key (all ANIC).

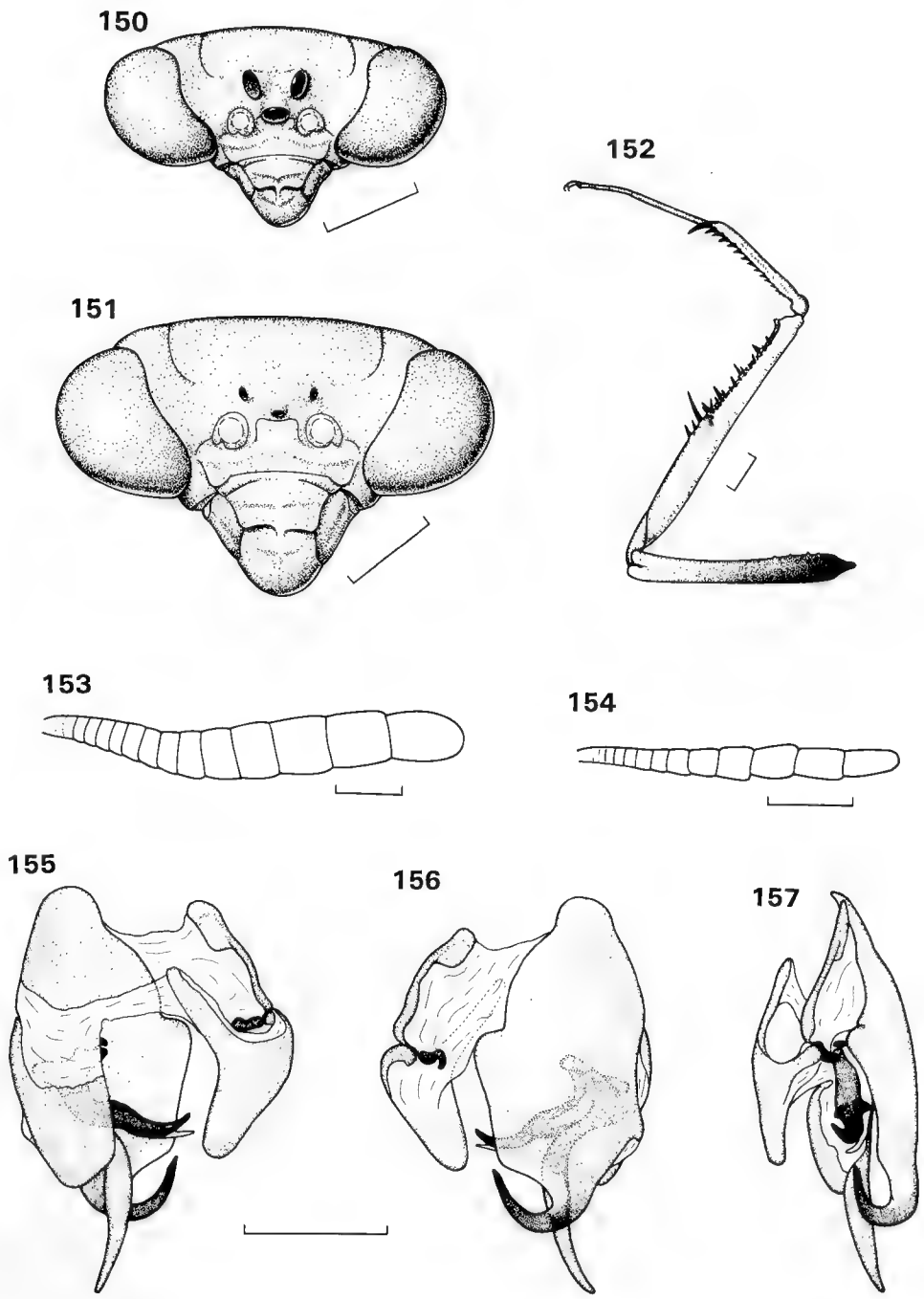
Other specimens examined. NT. 1 juv., nr Cahills Crossing, 18 km SW of Oenpelli, 20 Sep 1981. 1 juv., 12°52′S, 132°50′E, 15 km E of Mt Cahill, 12 Jun 1973. 1 juv., 12°22′S, 133°01′E, 6 km WSW of Oenpelli, 30 May 1973. 2 juv., 13°19′S, 132°47′E, Twin Falls Gorge, 52 km S of Mt Cahill, 26 Mar 1982 (all ANIC).

Diagnosis. Body slender, lateral margins of eyes rounded, lateral margins of pronotum and anterior margin of fore coxa not strongly armed, interior face of fore coxa becoming blackish proximally but without distinctive colour pattern, tegmina of female covering first 2½ abdominal tergites, apical segment of cercus with rounded margin, pa of male genitalia with single elongate process.

Description. Body of moderate size, rather slender in form particularly in the male; colour of dry specimens yellow-brown to chocolate brown, females often peppered with darker spots on abdomen, dosal surface of pronotum and outer face of fore legs. Head with slightly arched apical margin, eyes somewhat protuberent anteriorly with rounded lateral margins, frontal shield with distinct subantennal ridge. Prothorax slender, especially in male, with slight but distinct supracoxal expansion; prozona lightly granulate above, more strongly tuberculate below; metazona with fine mid dorsal keel, darkish between bases of fore coxae. Fore coxa (fig. 152) with number of small tubercles on anterior edge, more so in female, usually with two more prominent ones in proximal third; inner face pale distally, becoming blackish and faintly tubercled proximally. Fore femur with discoidal, outer, large inner and tips of small inner spines blackish. Foretibia with 14 inner and 8–10 outer spines, all tipped blackish brown. Mid and hind femora usually with small genicular spine. Wings of male extending just beyond sixth



Figures 148–149, *Archimantis gracilis*. 148, male; 149, female. Scale = 10 mm.



Figures 150–157, *Archimantis gracilis*. 150, male head; 151, female head; 152, male foreleg, inside; 153, female cercus; 154, male cercus; 155, male genitalia, dorsal; 156, male genitalia, ventral; 157, male genitalia, right lateral. Scale = 2 mm.

abdominal tergite. Tegmen of male hyaline except for costal area which has opaque white marginal band, followed by black band in proximal third, followed by brown band at costal margin of discoidal area and and orange-brown band in proximal third, these colours more intense below; stigma obscure. Tegmen of female extending to about middle of third abdominal tergite, costal and discoidal areas completely opaque, costal area dark blackish, discoidal area dark brown with fuscous reticulate pattern more prominent distally and roughly coinciding with veins; stigma usually indicated by paler area with blackish spot at proximal and distal end; colouring more intense beneath. Hindwing of male with distal two thirds of costal area flushed brown, remainder hyaline. Hindwing of female about four fifths as long as tegmen, costal area and longitudinal veins brown, rest of wing hyaline except for smokey area apically. Abdominal sternites 3–6 with blackish anterior margins; cercus (figs 153–154) elongate, terminal segment with rounded apical margin. Male genitalia (figs 155–157) with dpr of vph narrow at base, strongly recurved; anterior section of vl of lph rather small in area and situated noticeably to the left, with narrow elongate projection at junction with pa; apr with only slight medial bulge, extending well beyond dpr, tip simple; pa with single spiniform projection, initially directed posteriorly, then curving laterally, slightly sinusoidal with tip directed anterio-laterally, faintly shagreened except toward tip, with small more strongly shagreened ventrally directed secondary projection near elbow of main projection; apr very short.

Measurements (mm). Body length, ♂ 77–82, ♀ 90–98. Head width, ♂ 6.9–7.1, ♀ 8.5–8.8. Head depth, ♂ 4.2, ♀ 5.4–5.7. Pronotum length, ♂ 26–28, ♀ 33–35. Pronotum width, ♂ 3.1, ♀ 4.3–4.8. Fore coxa length, ♂ 13, ♀ 17–18. Fore femur length, ♂ 15, ♀ 20–21. Tegmen length, ♂ 41–43, ♀ 23–25. Cercus length, ♂ 7.3–8.0, ♀ 8.4–9.6.

Immature stages. Dry specimens of nymphs are more mottled than adults with indications of a pale mid dorsal abdominal stripe of uneven width. Ootheca unknown.

Etymology. Specific name derived from the Latin *gracilis* meaning slender or thin.

Distribution and habits. Only recorded from a small area in the East Alligator River region of the Northern Territory (fig. 174). Habits unknown but probably a shrub dweller.

Archimantis vittata sp. nov.

Figures 158–165, 174

Material examined. Holotype: ♂, 11°45′S, 142°35′E, Heathlands HS, Queensland, 22 Jan 1992, T.Weir (ANIC).

Paratypes: ♂, 11°08′S, 142°29′E, Jardine River, Cape York Peninsula, Queensland, 12 Oct 1979, M.S. and B.J. Moulds (AM). ♂, Dulhunty River Crossing, Cape York Peninsula, Queensland, 27–28 Sep 1974, G.B. Monteith (QM).

Diagnosis. Body slender, lateral margins of eyes rounded, lateral margins of pronotum and anterior margin of fore coxa not strongly armed, interior face of fore coxa becoming blackish proximally but without distinctive colour pattern, tegmen of male with diagonal bands in discoidal area, terminal segment of cercus with rounded apical margin, pa of male genitalia compact.

Description (male only). Body rather small for genus, elongate, slender, colour of dry specimens brown with darker speckling on abdomen and outer face of fore legs. Head with almost straight apical margin; eyes slightly protruberent anteriorly, lateral margins rounded; frontal shield with distinct subantennal ridge. Prothorax elongate and very slender, with slight but distinct supracoxal expansion, lateral margins very faintly tuberculate in prozona and anterior third of metazona; prozona faintly granulate above, more strongly tuberculate below; metazona with fine mid dorsal keel, dark reddish between bases of fore coxae. Fore coxa (fig. 160) with few, very small, blunt teeth on anterior edge; inner face pale distally, becoming blackish with few very small pale tubercles proximally. Fore femur with discoidal, outer, large inner and tips of small inner spines blackish. Fore tibia with 16–17 inner and 8–9 outer spines, all more or less tipped blackish brown. Mid and hind femora without genicular spine. Tegmen (fig. 161) reaching just beyond abdominal tergite 6; costal area with opaque white marginal band, narrowing distally and followed by darker band in proximal third which is brown above and black beneath; narrow zone between subcosta and radius dark brown, further band posterior to radius in proximal third which is cream above and yellow-orange below; discoidal area with major veins flushed brown giving banded appearance except for area posterior to stigma which, along with remainder of tegmen, is hyaline. Wing with distal half of costal area and zone between subcosta and radius flushed brown,

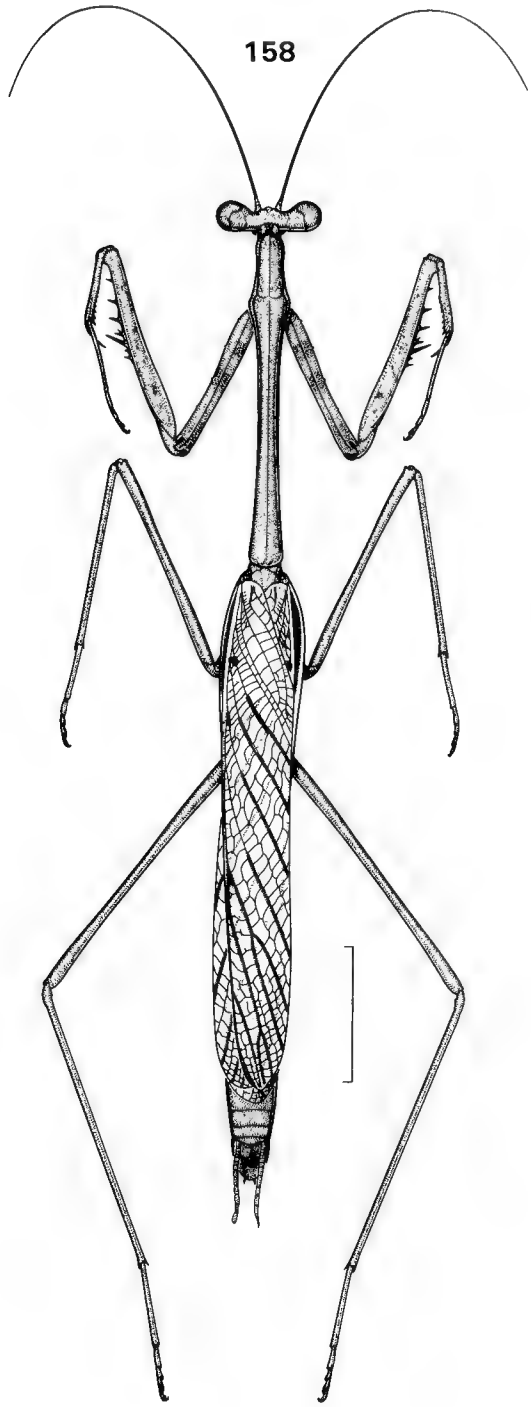
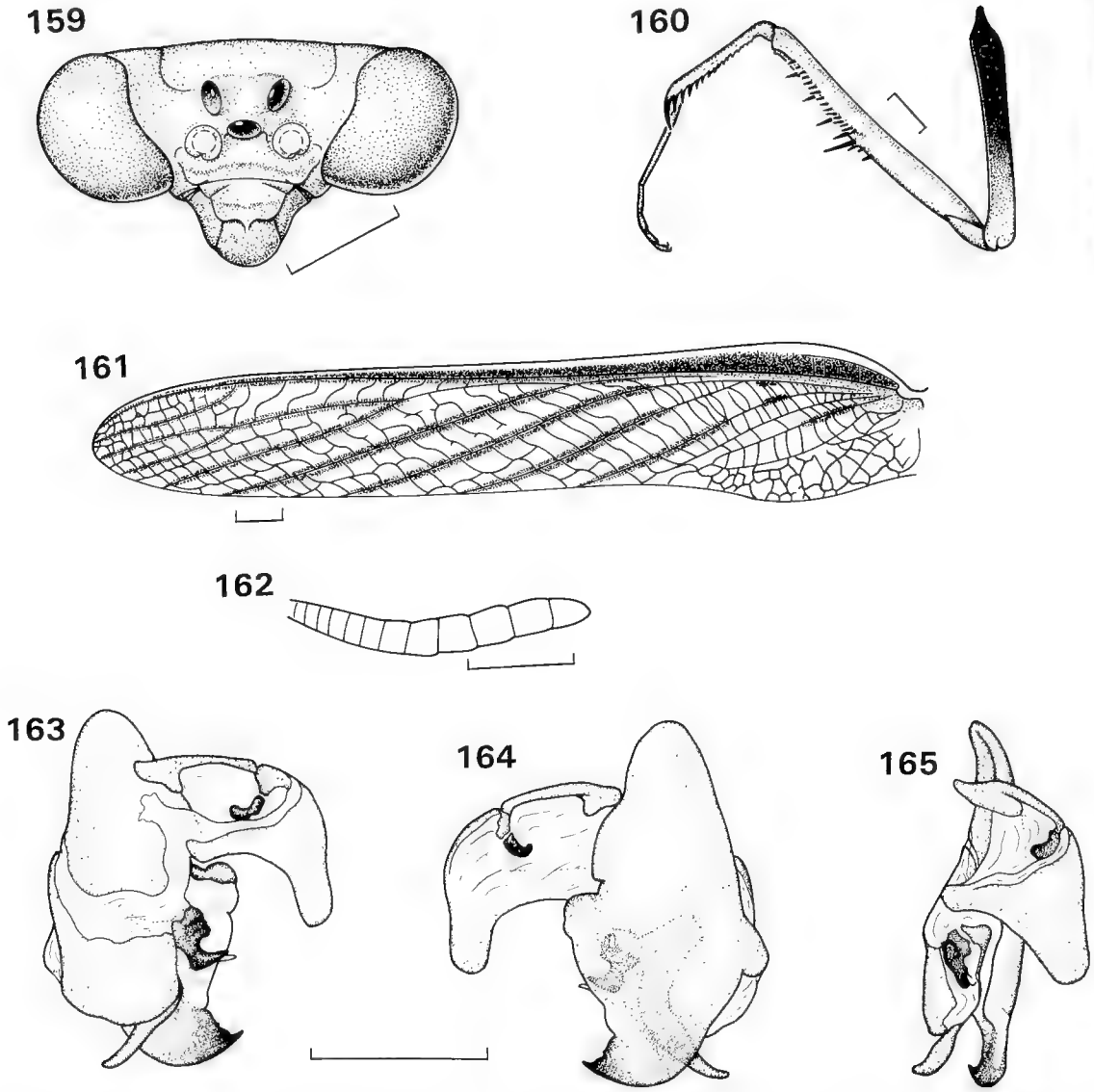


Figure 158, *Archimantis vittata*, male. Scale = 10 mm.



Figures 159–165, *Archimantis vittata*, male. 159, head; 160, foreleg, inside; 161, tegmen; 162, cercus; 163, genitalia, dorsal; 164, genitalia, ventral; 165, genitalia, right lateral. Scale = 2 mm.

remainder hyaline. Cerci (fig. 162) elongate, terminal segment with rounded apical margin. Male (figs 163–165) genitalia with dpr of vph compact, mandible like in appearance, with small tooth at apex, dorsal surface lightly ridged dextrad; anterior section of vl of lph with short broad projection at junction with pa; apr without noticeable median bulge, tip simple; pa compact and strongly shagreened anteriorly, with short, abruptly curved, uncinate posterior projection.

Measurements (mm). Body length, 66–67. Head width, 6.8. Head depth, 3.5. Pronotum length, 22–23. Pronotum width, 2.8–2.9. Fore coxa length, 10.8. Fore femur length, 13.5. Tegmen length, 35–36. Cercus length, 6.2.

Immature stages. Unknown.

Etymology. Specific name from the Latin *vittatus*, meaning decorated with bands.

Distribution and habits. Known only from three records near the tip of Cape York Peninsula (fig. 174). Habits unknown but probably a shrub dweller.

Acknowledgments

I would like to thank Dr T.Kronestedt (NHRM), Dr E.Matthews (SAM) and Dr J.van Tol (RNHL) for the loan of type material, Mr J.Balderson (ANIC) for allowing me to examine *Archimantis* type material in his care, Mr E.C.Dahms (QM), Mr T.Houston (WAM), Mr M.Moulds (AM), Dr D.Rentz (ANIC) and Ms M.Schneider (UQ) for the loan of specimens.

References

Balderson, J., 1984. Catalogue of Australian Mantodea. *CSIRO Technical Paper No* 23.

Beier, M., 1935. Mantodea: Fam. Mantidae: Subfam. Mantinae. *Genera Insectorum* 203: 1–146.

Beier, M., 1963. Neue und bemerkenswerte Mantiden verschiedener Herkunft. *Stuttgarter Beitrage zur Naturkunde* 106: 1–11.

Beier, M., 1964. Blattopteroidea. Ordung Mantodea Burmeister 1838 (Raptoriae Latrielle 1802; Mantoidea Handlirsch 1903; Mantidae auct.) *Bronn's Klassen und Ordnung des Tierreichs* (5) (3) 6: 849–970. (Geest & Portig : Leipzig).

Giglio-Tos, E., 1912. Mantidi Esotici. V. Mantes, Tenoderae, Hierodulae et Rhomboderae. *Societa entomologica Italiana, Bollettino* 43: 1–167.

Giglio-Tos, E., 1917. Mantidi Esotici. Generi e specie nouve. *Societa entomologica Italiana, Bollettino* 48: 43–108.

McCoy, F., 1886. *Natural history of Victoria. Prodromus of the zoology of Victoria, or, figures and descriptions of all classes of the Victorian indigenous animals.* Vol. 2, Decade 13: 79–118. Trubner and Co.: London.

Milledge, G., 1990. Revision of the genus *Nesoxypilus* Beier (Mantodea: Amorphoscelidae: Paraoxypilinae). *Memoirs of the Museum of Victoria* 50(2): 347–355.

Paijmans, K., 1975. Explanatory notes and vegetation map of Papua New Guinea. *CSIRO. Land Research Series No.*35.

Rentz, D.C.F., 1985. *Monograph of the Tettigoniidae of Australia. Volume 1, The Tettigoniinae.* CSIRO: Canberra.

Saussure, H. de, 1869. Essai d'un système des Mantides. *Mittheilungen der Schweizer entomologischen Gesellschaft* 3: 49–73.

Saussure, H. de, 1871. Mélanges orthopterologiques. Supplement au troisième fascicule. *Mémoires de la Société de Physique et d'Histoire Naturelle de Gèneve* 21: 239–336.

Saussure, H. de, 1873. Mélanges orthopterologiques. Fascicule 4. *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève* 23: 1–160.

Serville, J.G.A., 1838. *Histoire naturelle des insectes. Orthoptères.* Libraire Encyclopedique de Roret: Paris.

Sjöstedt, Y., 1918. Results of Dr E.Mjöberg's Swedish scientific expeditions to Australia 1910–1913. 17. Mantidae and Phasmidae. *Arkiv for Zoologi* 11(19): 1–60.

Tepper, J.G.O., 1905. Insects collected in the northwestern region of South Australia proper by H. Basedow; with descriptions of new species of Mantidae and Phasmidae. No.2. *Transactions, Proceedings and Reports of the Royal Society of South Australia* 29: 237–245.

Tindale, N.B., 1923. Review of Australian Mantidae. *Records of the South Australian Museum* 2: 425–457.

Werner, F., 1922. Zur Kenntnis der Manntodeenfauna der Niederlandischen Kolonien. *Zoologische Mededelingen* 7: 115–126.

Wood-Mason, J., 1877. On a small collection of orthopterous insects of the families Phasmidae and Mantidae from Australia and New Britain, with descriptions of four new species. *Annals and Magazine of Natural History* 20: 74–77.

Wood-Mason, J., 1878. On new and little known Mantidae. *Proceedings of the Zoological Society of London* 38: 580–587.

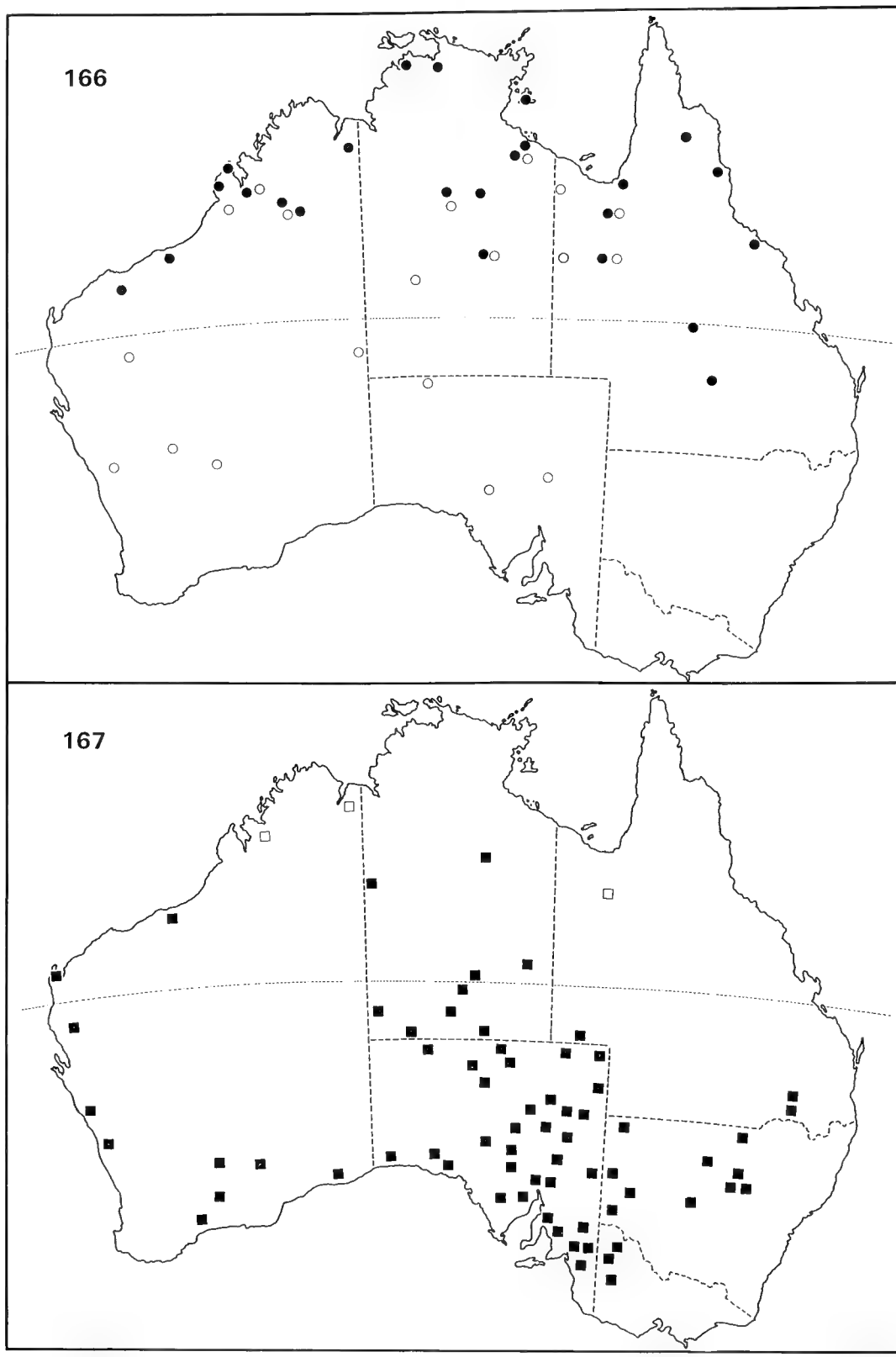


Figure 166. Distributions of *Austromantis albomarginata* (●) and *Nullabora flavoguttata* (○).
Figure 167. Distributions of *Corthylomantis baldersoni* (□) and *Coenomantis kraussiana* (■).

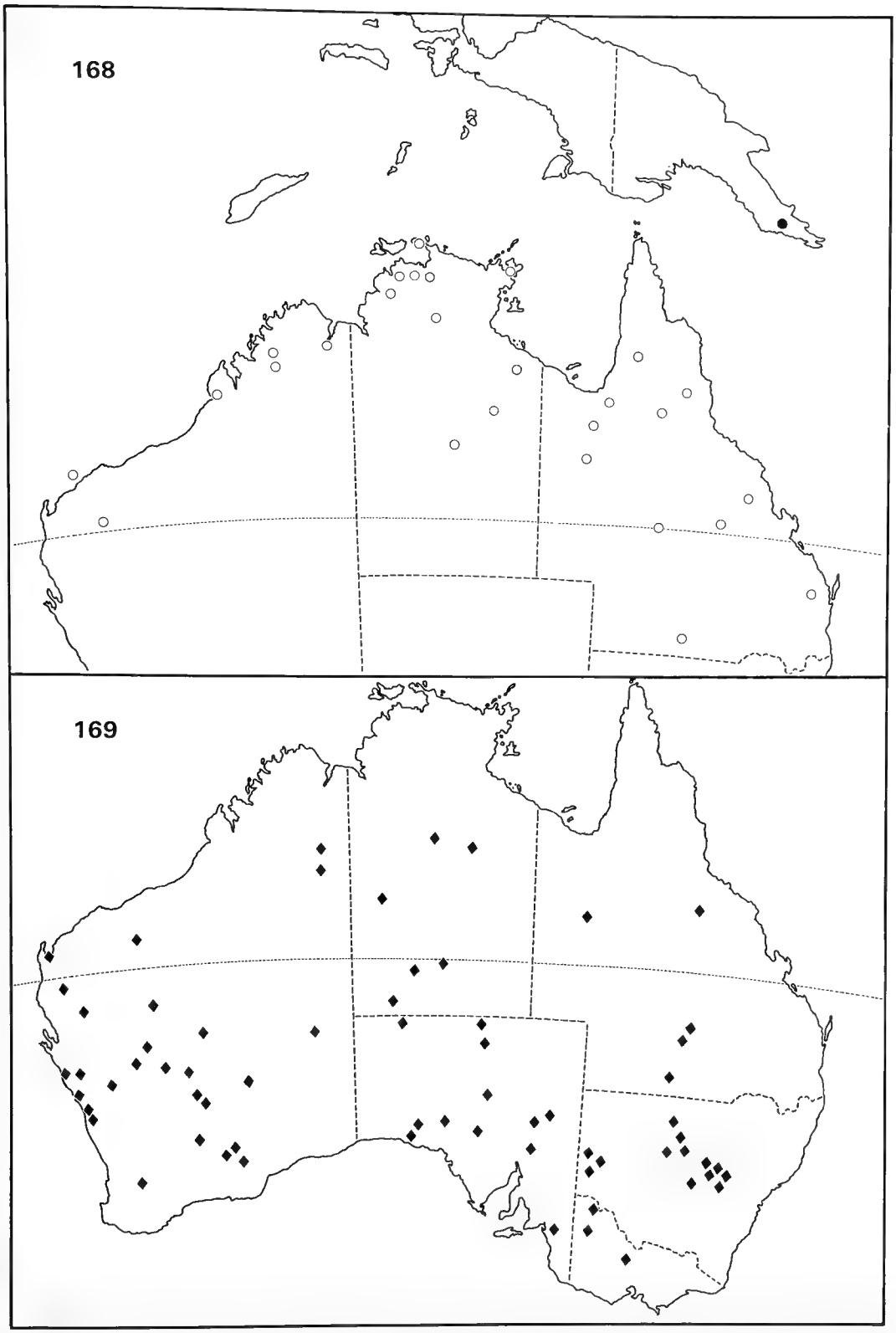


Figure 168. Distributions of *Austrovates variegata* (○) and *A. papua* (●).
Figure 169. Distribution of *Archimantis quinquelobata* (◆).

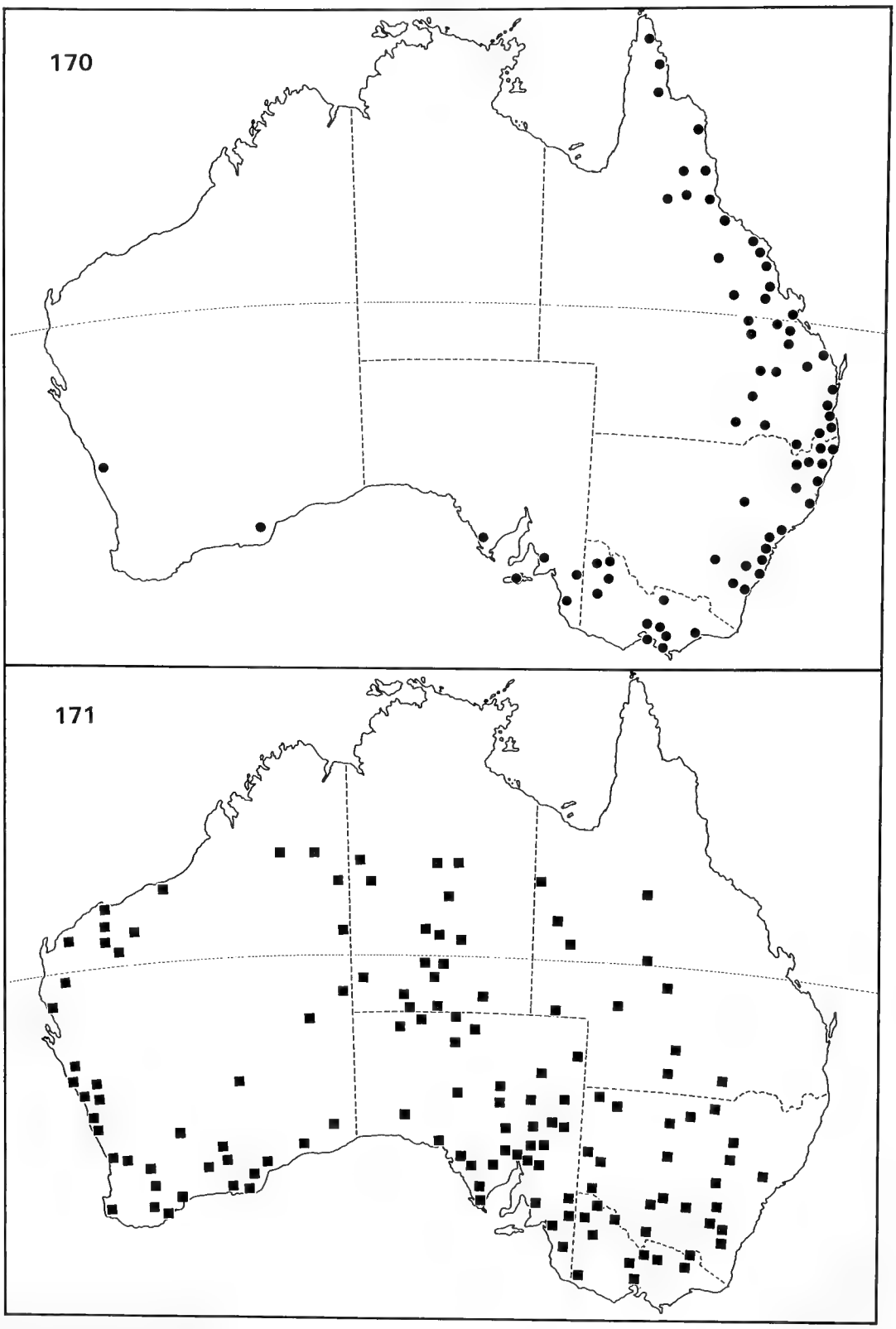


Figure 170. Distribution of *Archimantis latistyla* (●).
Figure 171. Distribution of *Archimantis sobrina* (■).

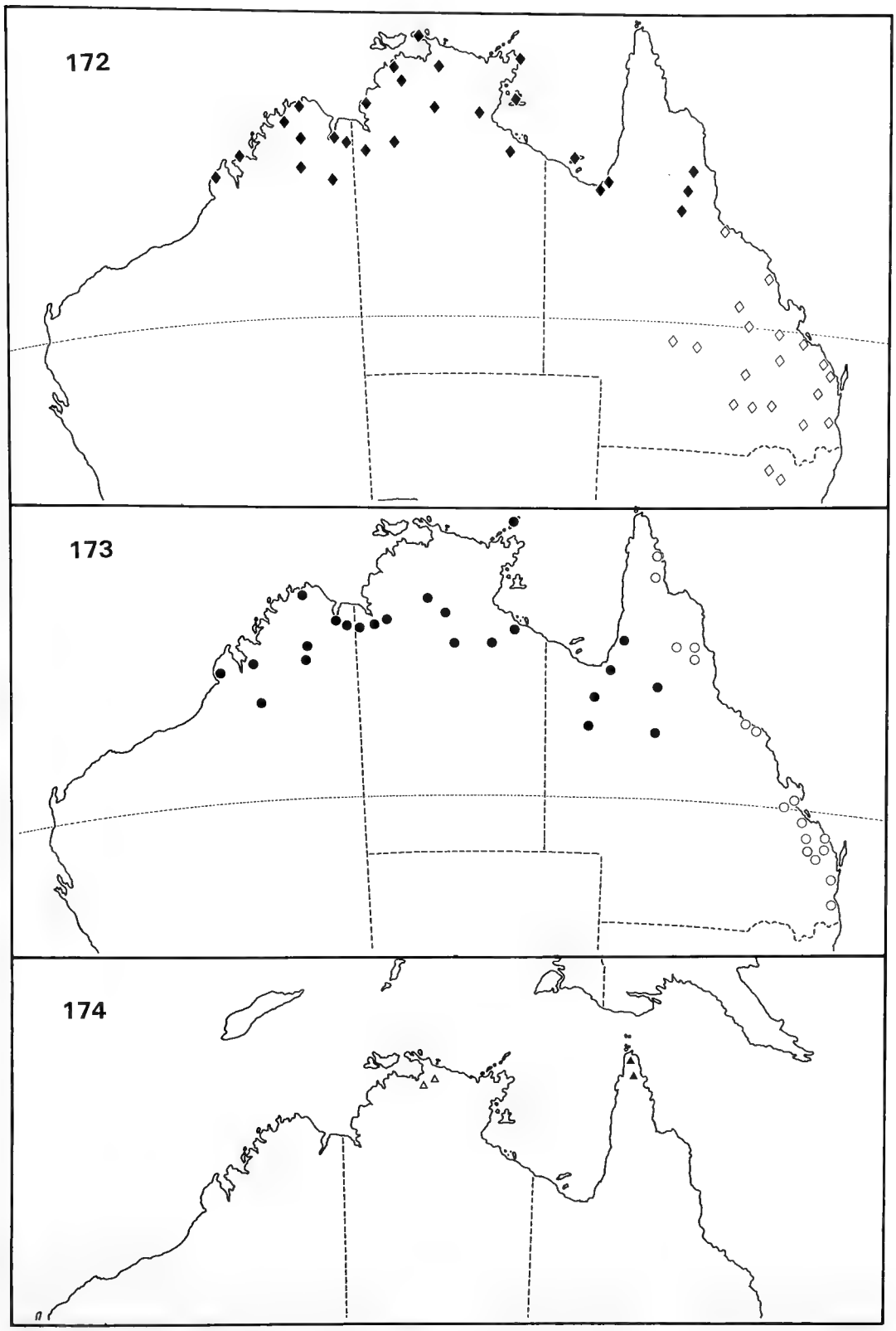


Figure 172. Distributions of *Archimantis monstrosa* (♦) and *A. armata* (◇).
Figure 173. Distributions of *Archimantis straminea* (●) and *A. brunneriana* (○).
Figure 174. Distributions of *Archimantis gracilis* (△) and *A. vittata* (▲).

Memoirs of the Museum of Victoria 56(1):65–68 (1997)

A NEW SPECIES OF *PROGRADUNGULA* FORSTER AND GRAY (ARANEAE: GRADUNGULIDAE) FROM VICTORIA

G. A. Milledge

Museum of Victoria, 71 Victoria Crescent, Abbotsford, Melbourne, Vic. 3067, Australia

Abstract

Milledge, G.A., 1997. A new species of *Progradungula* Forster and Gray (Araneae: Gradungulidae) from Victoria. *Memoirs of the Museum of Victoria* 56(1): 65–68.

Progradungula otwayensis, sp. nov., from the Otway Ranges in Victoria is described and notes on its biology are given.

Introduction

Progradungula carraiensis Forster and Gray from north-eastern New South Wales and *Macrogradungula moonya* Gray from north-eastern Queensland are the only two cribellate species of the primitive araneomorph family Gradungulidae currently known. *P. carraiensis* is only known from the type locality, Carrai Bat Cave in New South Wales (Gray, 1983), although Gray (Forster et al., 1987) suggests it may be slightly more widespread. *M. moonya* is known from the Boulder Creek region, near Tully in Queensland (Forster et al., 1987). Recent collecting in the *Nothofagus* forests of Otway Ranges in Victoria has revealed an undescribed species of *Progradungula* occurring at a number of sites.

Morphological descriptions are of the holotype male. For comparative purposes descriptive terminology and form follow Forster et al. (1987), except for leg spination which follows Platnick and Shadab (1975). Moran (1985), when describing *Gradungula brindabella* (now placed in *Kaiya*), noted the asymmetrical distribution of the leg spines in that species and adopted a simplified notation as a result. As the species described here displays a similar asymmetrical spine distribution, numbers and positions of leg spines given are those of the right legs only and should be taken as an approximation rather an absolute. Measurements are in millimetres. All material is housed in the Museum of Victoria (NMV).

Progradungula Forster and Gray

Progradungula Forster and Gray, 1979: 1053. Type species *Progradungula carraiensis* Forster and Gray, by original designation.

Diagnosis. See Forster et al. (1987) for diagnoses of this and other gradungulid genera.

Progradungula otwayensis sp. nov.

Figures 1–3

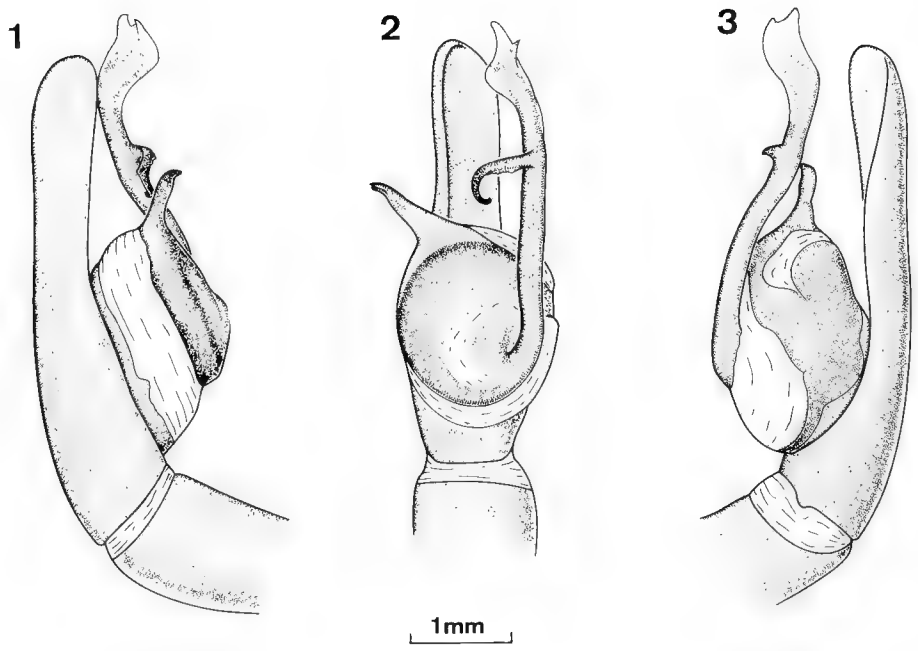
Material examined. Holotype: ♂, Victoria, Otway Ranges, Aire Crossing Track, 0.5 km N of Aire River crossing, 38°42′S, 143°29′E, 31 Jan 1995, G. Milledge, K3260 (NMV).

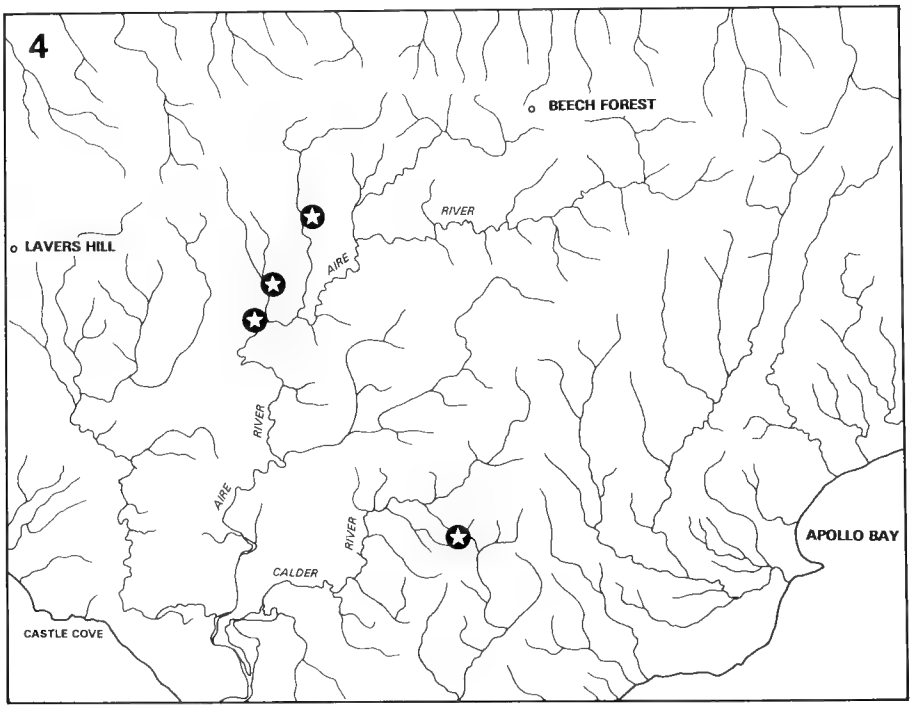
Paratypes: Vic. 3 ♂ juvs., 1 ♀ juv. same data as holotype, K3261; 2 ♂ juvs., Otway Ranges, Young Creek Rd, 0.2 km NE of Ciancio Creek crossing, 38°42′S, 143°29′E, 31 Jan 1995, G. Milledge, K3262; 3 juvs., Otway Ranges, Phillips Track, 0.5 km N of Triplet Falls, 38 °40′S, 143°29′E, 30 Jan 1995, G. Milledge, K3263; 3 juvs., as above except 20 Feb 1992, K2473–5; 1 juv., as above except 17 Mar 1992, K2476; 1 juv., Otway Ranges, Maits Rest, 10 km W of Apollo Bay, 38°45′S, 143°19′E, 20 Feb 1992, G. Milledge, K2477 (all NMV).

Etymology. Specific name refers to the region where this species has been collected.

Diagnosis. This species can be separated from *P. carraiensis* by the presence a single parembolic process on the male palpal embolus.

Description. As in *P. carraiensis* except as follows. Carapace 5.42 long, 3.98 wide. Abdomen 5.40 long, 4.75 wide. Colour: carapace pale fawn except for orange-brown eye region and pale grey patch anterior to fovea, chelicerae dark brown; abdomen light mauvish grey with paler mid-dorsal stripe on anterior half and 3 pairs of pale dorsolateral chevrons on posterior half; legs pale fawn proximally becoming darker brown distally. Eye sizes and interdistances: AME 0.15, ALE 0.29, PME 0.25, PLE 0.25, AME-AME 0.18, AME-ALE 0.26, PME-PME 0.26, PME-PLE 0.31, ALE-PLE 0.08; MOQ length 0.69, front width 0.48, rear width 0.76. Cheliceral stridulatory area small, similar to that of *Macrogradungula* (Davies, 1993), also present in juveniles but less well developed. Cheliceral groove with 4 large promarginal teeth and 3–4 much smaller retromarginal denticles. Labium 0.69





Figures 1–3. Right palp of holotype male of *Progradungula otwayensis* (hairs omitted). 1, prolateral; 2, ventral; 3, retrolateral.
Figure 4. Distribution of *Progradungula otwayensis*.

long, 0.85 wide. Sternum 2.75 long, 1.81 wide. Leg formula 1423. Spination: femora: I d1–0–1, p3–4–4, r3–3–3, v0–1–0; II d2–2–1, p3–3–4, r3–2–3, v0–3–0; III d1–1–1, p1–3–4, r3–3–4, v2–2–0; IV d1–4–1, p1–3–1, r4–1–3, v1–0–0; tibiae: I d1–0–1, p3–2–2, r2–1–2, v1–1–1; II d1–0–1, p2–2–2, r1–1–2, v2–2–3; III d1–1–1, p1–1–2, r2–1–1, v3–2–2; IV d1–1–0, p2–2–1, r1–1–2, v4–3–1; tarsi I p2–1–0, r2–1–0, v3–3–1; II p2–2–2, r2–1–1, v4–4–3; III p3–2–2, r2–1–2, v3–4–4; IV 3–2–2, r2–1–2, v4–3–4.

	I	II	III	IV	Palp
Femur	10.64	8.07	7.41	8.55	3.04
Patella	2.37	2.18	1.52	1.90	0.76
Tibia	10.92	8.36	6.56	8.08	2.95
Metatarsus	11.40	9.12	7.60	9.31	—
Tarsus	2.56	2.28	1.80	2.25	1.80
Total	37.89	30.01	24.89	30.09	8.55

Palpal bulb (figs 1–3) with single parembolic process on embolus, tip of embolus with membranous area more expansive and indentatation more pronounced than that shown in the illustration of *P. carraiensis* by Gray (1983). Palpal spination: femur: d0–1–2, p0–0–1, r0–1–1; tibia: p0–2–0.

Distribution and habits. Known from several localities in the Otway Ranges (fig. 4). So far this species has only been collected from the vicinity of *Nothofagus cunninghamii* trees and later instars appear dependant on the hollows that are often found in the bases of older trees for daytime retreats (although one web has been seen in the hollow stump of a nearby eucalypt). Web structure and defensive behaviour are similar to that described for *P.carraiensis* (Gray, 1983; Forster et al., 1987) although the web structure of *P.otwayensis* has not been as closely studied. The catching ladder and supporting web is sometimes constructed several metres from the retreat, to which it is attached by a single sturdy guyline, but more commonly it is constructed in the vegetation surrounding the base of the tree or in the sucker-like shoots growing from the tree trunk. It may be attached to the ground but more often is built amongst the vegetation, up to two metres above ground. The spiders are only active at night and assume their catching position an hour or so after sunset. The egg case is unknown.

Remarks. As noted in the introduction, the leg spine count of the holotype for this species is variable so, although the overall number appears to be significantly lower than that of *P. carraiensis*, further adult specimens are required before the usefulness of this character can be ascertained. The lack of an adult female for the description of this species means it may be misplaced in *Progradungula*. This is because Gray (Forster et al., 1987) used female characters to separate *Macrogradungula* from *Progradungula*, as no male of *Macrogradungula* was available. However, due to the similarities in dimensions and form of the body, and of the cheliceral teeth, of the male of this species and that of *P. carraiensis*, it is reasonable to place it in *Progradungula*.

The presence of the cheliceral stridulatory area in this species and in *Macrogradungula*, but apparently not in *P. carraiensis*, would appear significant. However, it seems that this feature is present in the male holotype of *P. carraiensis* but was overlooked in the original description (M. Gray, pers. comm.). More specimens are needed before the relationships between *Macrograndungula* and *Progradungula* can be clarified.

Although this species has been collected from a number of sites in the Otway Ranges, its apparent dependence on mature *N.cunninghamii* trees for refuges may make its survival somewhat precarious unless areas where Myrtle Beech occurs are preserved.

References

Davies, V.T., 1993. The spinning field and stridulating apparatus of penultimate male *Macrogradungula moonya* (Araneae: Austrochiloidea: Gradungulidae). *Memoirs of the Queensland Museum* 33(1): 175–178.

Forster, R.R. and Gray, M.R., 1979. *Progradungula*, a new cribellate genus of the spider family Gradungulidae (Araneae). *Australian Journal of Zoology* 27: 1051–1071.

Forster, R.R., Platnick, N.I. and Gray, M.R., 1987. A review of the superfamilies Hypochiloidea and Austrochiloidea (Araneae, Araneomorphae). *Bulletin of the American Museum of Natural History* 185: 1–116.

Gray, M.R., 1983. The male of *Progradungula carraiensis* Forster and Gray (Araneae, Gradungulidae) with observations on web and prey capture. *Proceedings of the Linnean Society of New South Wales* 107(1): 51–58.

Moran, R.J., 1985. *Gradungula brindabella* (Araneae: Gradungulidae), a new species of hypochyloid spider from eastern Australia. *Bulletin of the British Arachnological Society* 6: 304–308.

Platnick, N.I. and Shadab, 1975. A revision of the spider genus *Gnaphosa* (Araneae, Gnaphosidae) in America. *Bulletin of the American Museum of Natural History* 155: 1–66.

Memoirs of the Museum of Victoria 56(1):69–82 (1997)

SUPPLEMENT TO A REVISION OF AUSTRALIAN MEMBERS OF THE BEE GENUS *HOMALICTUS* (COCKERELL) (HYMENOPTERA: HALICTIDAE)

KENNETH WALKER

Department of Entomology, Museum of Victoria,
71 Victoria Crescent, Abbotsford. Vic. 3067, Australia

Abstract

Walker, K., 1997. Supplement to a revision of Australian members of the bee genus *Homalictus* (Cockerell) (Hymenoptera: Halictidae). *Memoirs of the Museum of Victoria* 56: 69–82.

Five new species, *Homalictus adiazetus*, *H. pilosignya*, *H. megagnathus*, *H. sicarius* and *H. verticulus*, the males of *H. andrewsi* (Kirby), *H. atrus* Walker and *H. maitlandi* (Cockerell) and female of *H. forrestae* are described. The discovery of *H. megagnathus* extends the known distribution of *H.* (*Papualictus*) Michener, previously New Guinea, into north-eastern Australia and requires the subgeneric diagnosis to be revised. Inferred species relationships, based on newly available character states, are revised.

Introduction

Walker (1986) revised and inferred sister-group relationships for 39 known species of Australian *Homalictus* Cockerell. A supplement to that revision is now necessary. Five new species are recognised, including the first Australian species of the subgenus *Papualictus* Michener and males of three and the female of one previously known species are described and figured for the first time. These species and additional character states (both sexes: head, mesoscutum and propodeum sculpture characteristics; and male genitalia) are used to revise inferred species-group relationships.

Terminology and Abbreviations

Terminology and methods follow Walker (1986) with these exceptions: the gaster is called the metasoma; the forewing length measurement is taken from the base of the arcuate basal vein (M) to the distal-most margin of the third submarginal cell (2nd r-m); and, relative head measurements are standardised to a head width of 100 units allowing them to be expressed as a percentage and therefore directly compared between sexes and species. Sculpture definitions follow Harris (1979) and punctation density rates are defined as: dense — interspaces between punctures less than diameter of a puncture; close — interspaces between punctures equal to diameter of puncture; open — interspaces between punctures greater than one but less than twice diameter of puncture; sparse — interspaces between punctures equal to or greater than twice diameter of puncture.

Institutions are abbreviated as follows: AM, Australian Museum, Sydney, New South Wales; ANIC, Australian National Insect Collection, CSIRO, Canberra, Australian Capital Territory; BCRI, Biological and Chemical Research Institute, Rydalmere, Sydney, New South Wales; BMNH, Natural History Museum, London (statutory name: British Museum (Natural History)); NMV, Museum of Victoria, Melbourne, Victoria.

Descriptive abbreviations are as follows: AOD, antennocular distance; CL, clypeus length; CW, clypeus width; EW, eye width in side view; FL, flagellum length; GL, glossa length; GW, maximum genal width in side view; HL, head length; HW, head width; IAD, interantennal distance; IOD, interocellar distance; LID, lower interorbital distance; ML, mandible length; OAD, ocellantennal distance; OOD, ocellocular distance; S1-S8, metasomal sterna 1–8; SL, scape length; T1-T5, metasomal terga 1–5; UID, upper interorbital distance.

Homalictus Cockerell

Homalictus Cockerell, 1919: 13. Type species: *Halictus taclobanensis* Cockerell, 1915: 488 (by original designation).

Subgenus *Homalictus*

Diagnosis. See Walker (1986: 115).

Homalictus (Homalictus) adiazetus sp. nov.

Material examined. Holotype. ♀ Qld, Bunya Mts (26°51′S, 151°34′E), 22 Jan 1938, N. Geary, 2000 ft (610 m) (AM; Missing right hind tarsal segments.)

Paratype. 1♀ NSW, Minnamurra Falls (34°38′S, 150°43′E), 10 Feb 1962, C.E. Chadwick (BCRI).

Diagnosis. A member of the "*sphecodoides*" species-group (see Walker (1986) for species-group definitions); female with frons striate above antennal bases, pronotum dorsolateral

angles sharply acute, mesoscutum mesially and posteriorly densely punctate, parapsidal areas scabrous, dorsal surface of propodeum striate with a few interconnectives mesially.

Description of female. (male unknown) (measurements of holotype in bold). Body length: 5.18–**5.39** mm; Forewing length: 1.48–**1.51** mm; Head width: **1.47**–1.49 mm. Relative head measurements: HW: 100; HL: 81–**82**; UID: **58**–59; LID: **54**–55; AOD: 18–**20**; IAD: 9–**10**; OAD: 33–**34**; IOD: 16–**17**; OOD: 15–**16**; CL: 18–**19**; GW: **16**–17; EW: **24**–25; SL: **44**–45; FL: 80–**82**.

Structure. Head broad, inner orbits converging below, median frontal carina almost absent, extending just beyond supraclypeal area, eyes with sparse cover of minute setae. Scape reaches at least posterior margin of median ocellus. Clypeus weakly convex, in side view, anterior half shining, densely to closely punctate with large, deep punctures, posterior half dull, covered with a fine reticulate pattern, sparsely punctate with small, shallow punctures. Frons striate above antennal bases to level of posterior margin of median ocellus, sculpture laterally striate though weakened to smoothly and sparsely punctate along inner margin of eyes, lower paraocular areas smooth, shining and glabrous; vertex almost smooth, with a few transverse striae. Pronotum dorsolateral angles sharply acute, weakly projected. Mesoscutum surface dull, anterior margin straight, anteriorly sparsely punctate, mesially and posteriorly densely punctate, parapsidal areas scabrous, punctures contiguous with raised edges. Scutellum shining, closely to densely punctate, scutellum length equal to length of dorsal surface of propodeum. Dorsal surface of propodeum not defined by carinae, sculpture broadly striate with a few interconnectives mesially, sculpture reaches lateral margins only. Mesepisternum and metepisternum smooth, covered with a fine reticulate pattern. Fore basitarsal comb fan shaped, hind basitibial plate apically rounded, inner hind tibial spur coarsely serrate with apices of at least five teeth, their bases fused.

Colour. Head, scutellum and propodeum black, antennal scapes dark brown, flagellum segments light brown; mesoscutum dull with a dark blue hue; metasoma red-brown suffused with dark brown apically; legs red-brown except femora, trochanters and coxae a darker brown.

Vestiture. Body sparse, head and mesoscutum with short erect, minutely branched hair, metanotum and lateral margins of scutellum densely hirsute; metasomal T1–T2 glabrous, T3–T4 with sparse hair cover.

Distribution. South-eastern Queensland and coastal central New South Wales.

Etymology. The epithet "*adiazetus*" means unpolished and refers to the sculpture pattern on the head and mesoscutum.

Remarks. Homalictus adiazetus body colour patterns are similar to *H. megastigmus* (Cockerell) and *H. niveifrons* (Cockerell) but the coarse vertical striae on the frons and the densely punctate mesoscutum differs from both.

Homalictus (Homalictus) andrewsi
(Kirby) comb. nov.

Figures 1–3

Halictus andrewsi Kirby, 1900: 86.

Syntypes. 11♀, Christmas Island, north part of the island, January 1898, Andrews (BMNH; not examined).

Material examined. Christmas I. 52♀ Ethel Beach (10°28′S, 105°42′E), 15 Apr 1989, J.C. Cardale (collected in either closed forest or yellow trays); 7♀, 2♂ nr Grants Well (10°29′S, 105°39′E), 15, 24 and 29 Apr 1989, J.C. Cardale (♂ collected at light); 5♀, 1♂ Central Area Wkshp (10°29′S, 105°38′E), 14–15 Apr 1989, J.C. Cardale; 1♀ Lily Beach Road (10°28′S, 105°42′E), 13–28 Apr, J.C. Cardale, malaise trap/trough. (ANIC).

Diagnosis. A member of the *urbanus* species-group; female with frons finely striate, pronotum dorsolaterally rounded, mesoscutum posterior two thirds densely punctate, dorsal surface of propodeum smooth except with several striae on basal half; male with frons striate, mesoscutum impunctate, genae with conspicuous cover of long, plumose hair.

Description of female. Body length: 5.24–5.78 mm; Forewing length: 1.32–1.41 mm; Head width: 1.55–1.62 mm. Relative head measurements: HW: 100; HL: 88–91; UID: 48–49; LID: 51–52; AOD: 18–19; IAD: 09–10; OAD: 33–34; IOD: 15–16; OOD: 09–10; CL: 20–21; GW: 17–19; EW: 26–27; SL: 45–46; FL: 95–98.

Structure. Head elongate, inner orbits diverging below, ocellocular distance markedly less than interocellar distance. Frons finely striate, striae with interconnectives giving appearance of a widely spaced reticulate pattern, supraclypeal area and clypeus dull, covered with minute reticulate pattern, almost impunctate except for several weak, sparse, shallow punctures. Pronotum dorsolaterally rounded, not well projected. Mesoscutum and scutellum dull, covered with a

conspicuous minutely reticulate pattern, anterior half of mesoscutum sparsely punctate, posterior two thirds and scutellum densely punctate with shallow punctures. Dorsal surface of propodeum not defined by carinae, surface dull, smooth except with several striae on basal half. Metasomal terga impunctate.

Description of male. Body length: 4.69–4.80 mm; Forewing length: 1.19–1.22 mm; Head width: 1.32–1.34 mm. Relative head measurements: HW: 100; HL: 91–93; UID: 54–55; LID: 40–41; AOD: 13–14; IAD: 11–12; OAD: 31–33; IOD: 14–15; OOD: 14–15; CL: 21–22; GW: 16–17; EW: 29–30; SL: 36–37; FL: 114–116.

Structure. Head elongate, inner orbits converging below, not strongly so, scape just reaches anterior margin of median ocellus. Remainder of body similar to female except: frons sculpture distinctly striate, supraclypeal area, clypeus, mesoscutum and scutellum impunctate, all dull and covered with a conspicuous reticulate pattern, dorsal surface of propodeum sculpture restricted to basal margin.

Colour. Head and mesosoma dull metallic green, head with a golden sheen, metasoma with dark emerald green, surface with distinctive sheen; legs with coxae and femora dark green except mid femora suffused with red-brown, tibiae and tarsi red-brown and variously suffused with dark brown.

Vestiture. Body sparse, head and mesoscutum with sparse cover of short, erect, branched hair, genae with conspicuous cover of long, plumose hair forming a beard, metasomal sternites with moderate cover of erect, plumose hair, hair not forming distinctive pattern.

Genitalia and associated sterna. (figs 1–3).

Distribution. Christmas Island.

Remarks. The male is described and figured here for the first time. Kirby's description of the female is adequate for species recognition, however, the partial redescription presented here provides characters necessary for comparative purposes. *Homalictus andrewsi* is most like *H. urbanus* (Smith) but differs in both sexes by the sculpture on the dorsal of the propodeum (*andrewsi*- almost smooth; *urbanus*- coarsely ruguloso-striate). The shape of the eyes in the female (inner orbits diverging below) does not occur in any other member of the *urbanus* species-group. Kirby (1900) described two halictids, *Halictus andrewsi* and *H. binghami* (the latter now placed under *Pachyhalictus* Cockerell; see Michener (1978)), from the collections made by Mr C. Andrews on Christmas Island in 1898. Ms J. Cardale collected extensively (direct sweeping, yellow pan, malaise and light traps) on Christmas Island in 1989 yet the only halictid species collected was *H. andrewsi* (pers. comm. J.C. Cardale). *Pachyhalictus binghami* may now be extinct.

Homalictus (Homalictus) atrus Walker

Figures 4–6

Homalictus atrus Walker, 1986: 122.

Material examined. Holotype, ♀ Qld, Moses Ck, 4 km NE Mt Finnigan (15°47′S, 145°17′E), 14–16 Oct 1980, J.C. Cardale (ANIC).

Other specimens examined: Qld: 13♀, 19♂ McIlwraith Range, 30 km E of Coen (13°50′S, 143°17′E), 3 Nov 1988, K. Walker (NMV).

Diagnosis. A member of the "*blackburni*" species-group; male with frons impunctate, clypeus black, pronotum dorsolateral angles acute, mesoscutum sparsely to openly punctate, dorsal surface of propodeum sculpture ruguloso-striolate, fore and mid leg tarsal segments flanged laterally, genal hairs long, fore leg coxae and trochanters and mid and hind coxae with dense cover of long, plumose hair, lateral margins of fore tarsi with long, simple hairs, rasp-like sculpture on the apicoventral surface of the genitalia volsellae.

Description of male. Body length: 4.24–4.47 mm; Forewing length: 1.01–1.06 mm; Head width- 1.27–1.29 mm. Relative head measurements: HW: 100; HL: 86–88; UID: 58–61; LID: 34–35; AOD: 12–13; IAD: 10–11; OAD: 35–37; IOD: 18–20; OOD: 14–15; CL: 20–21; GW: 15–16; EW: 32–33; SL: 28–30; FL: 175–179.

Structure. Head broad, sculpture smooth, covered with a finely reticulate pattern, frons and supraclypeal area impunctate, clypeus sparsely punctate; inner orbits converging strongly below; scape reaches well short of anterior margin of median ocellus. Pronotum dorsolateral angles acute, weakly produced. Mesoscutum and scutellum dull, microtessellate, both sparsely to openly punctate with shallow punctures. Dorsal surface of propodeum not defined by carinae, sculpture ruguloso-striolate, extends to dorsal rim. Fore and mid leg tarsal segments flanged laterally.

Colour. Body black except antennal flagella dark brown; legs brown except tarsi light red-brown.

Vestiture. Body sparse except genal hairs long, forming a "beard", mesoventral area and fore

leg coxae and trochanters with dense cover of long, plumose hair, mid and hind coxae and trochanters with similar hair, forming a moderate cover; lateral margins of fore tarsi with long, simple hairs.

Genitalia and associated sterna. (figs 4–6).

Distribution. Cape York Peninsula and north Queensland.

Remarks. The male is described and figured here for the first time. *Homalictus atrus* is most like *H. luteipes* (Friese) but differs in both sexes by colour and sculpture characters (*atrus* ♀: tibiae black, propodeum openly ruguloso-striolate, ♂: clypeus black, propodeum ruguloso-striolate; *luteipes* ♀: tibiae light red-brown, propodeum closely ruguloso-striolate, ♂: clypeus dull white on lower one third, propodeum weakly striolate). Female characters alone inferred a sister-group relationship of *H. atrus* with *H. luteipes* (Friese), a Papua New Guinea species. However, with additional male characters and new species now available, two clades involving five species seem apparent. Prominent projections on the apicoventral surface of the genitalia volsellae provide a synapomorphy for a clade containing *H. luteipes* (fig. 4), *H. cassiaefloris* (Cockerell) (see Walker, 1986: fig. 19a) and *H. eurhodopus* (Cockerell) (see Walker, 1986: fig. 19d). Fore leg vestiture (fore leg coxae and trochanters with dense cover of long, plumose hair and lateral margins of fore tarsi with long, simple hairs) and the rasp-like sculpture on the apicoventral surface of the genitalia volsellae provide synapomorphies for a second clade containing *H. atrus* and *H. pilosignya* sp. nov.

Homalictus (Homalictus) forrestae Walker

Homalictus forrestae Walker, 1986: 139.

Material examined. Qld, Heathlands (11°45'S, 142°35'E): 2♀ 25 Jul–18 Aug; 1♂ Jun–25 Jul; 2♀ 18 Aug–18 Sep; 1♀ 18 Sep–21 Oct; 1992, P. Zborowski, J. Cardale, T. Weir, L. Miller and E. Nielsen, ex Malaise trap. (ANIC)

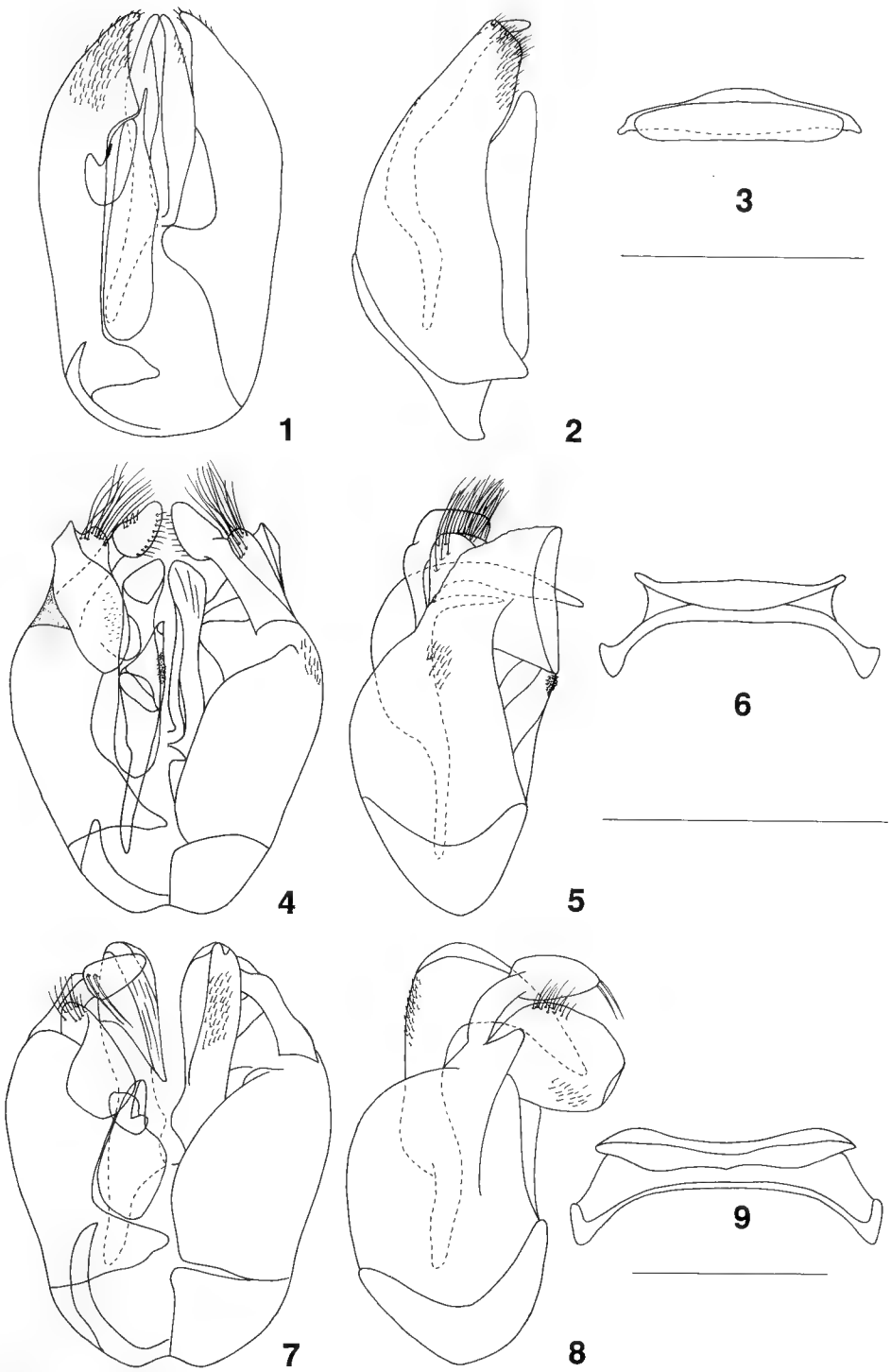
Diagnosis. A member of the "*forrestae*" species-group; female with frons weakly striate, pronotum dorsolaterally rounded, mesoscutum mesially closely to densely punctate, openly to closely punctate in parapsidal areas, dorsal surface of propodeum sculpture coarsely ruguloso-striate, anterior surface of hind tibia with hairs nearly simple, bristlelike or with 1 or 2 branches (no area with abundant, short, erect, plumose hairs as is usual for the genus), hind tibiae slender, under surface scarcely concave.

Description of female. Body length: 4.62–4.85 mm; Forewing length: 0.87–0.96 mm; Head width: 1.24–1.32 mm. Relative head measurements: HW: 100; HL: 92–94; UID: 64–65; LID: 56–58; AOD: 18–19; IAD: 09–10; OAD: 36–37; IOD: 18–19; OOD: 18–19; CL: 20–21; GW: 16–17; EW: 27–28; SL: 40–41; FL: 70–72.

Structure. Head elongate, inner orbits converging strongly below, median frontal carina present, reaches less than halfway to median ocellus; eyes with sparse cover of minute setae. Scape elongate, just reaches anterior margin of median ocellus. Clypeus with more than two-thirds projected below lower margins of eyes, weakly convex in side view, anterior margin straight, anterior half with several, large puncture, posterior half openly to sparsely punctate with small, shallow puncture, supraclypeal area sparely punctate. Frons and genae weakly striate, striae reach anterior margin of lateral ocelli, vertex smooth. Pronotum dorsolaterally rounded, weakly projected. Mesoscutum surface dull, covered with microtessellate pattern, anteriorly impunctate, mesially closely to densely punctate, openly to closely punctate in parapsidal areas. Scutellum openly to closely punctate, scutellum length equal to length of dorsal surface of propodeum. Dorsal surface of propodeum not defined by carinae, sculpture coarsely ruguloso-striate, extends to dorsal rim. Mesepisternum and metepisternum striate. Anterior surface of hind tibia with hairs nearly simple, bristlelike or with 1 or 2 branches (no area with abundant, short, erect, plumose hairs as is usual for the genus); hind tibiae slender, under surface scarcely concave; hind basitibial plate apically rounded; inner hind tibial spur coarsely serrate with 2 teeth.

Colour. Head blue-green, though frons above antennal bases, supraclypeal area and basal half of clypeus with copper tinge, remainder of clypeus black; antennae dark brown except underneath of flagellar segments light brown; mesoscutum and scutellum green-blue suffused with copper tinge, propodeum dark blue, metasomal terga dark brown; legs with coxae, trochanters and femora dark brown, apical end of femora, tibiae and tarsi light red-brown.

Vestiture. Body sparse, except tomentose hair on pronotum mesodorsal and dorsolateral areas, lateral margins of propodeum with long plumose hair; ventral metasomal scopae as usual for the genus, hind leg scopae present though not as pubescent as is usual for the genus.



Figures 1–9. *Homalictus* spp. male genitalia. *H. andrewsi*: figs 1–3: ♂, Christmas Island, Grants Well, Apr 1989, J.C. Cardale., ANIC. *H. atrus*: figs 4–6: ♂, Qld, McIlwriath Range, 30 km E of Coen, 3 Nov 1988, K. Walker, NMV. *H. maitlandi*: figs. 7–9: ♂, Qld, Claudie River, 1 mi W of Mt Lamond, 19 Dec 1971, D.K. McAlpine, G.A. Holloway, D.P. Sands, AM. 1, 4, 7: ventral view (left half) and dorsal view (right half); 2, 5, 8: lateral view; 3, 6, 9: metasomal S7 and S8. Scale lines (associated with each species) = 0.5 mm.

Distribution. Cape York Peninsula and western Queensland.

Remarks. The Heathlands population was identified as *H. forrestae* after comparison of the genitalia of the single new male with that of the male holotype from western Queensland. The female is described and figured here for the first time and its character suite confirms the inferred sister-group relationship with *H. urbanus*. *Homalictus forrestae* is most like *H. urbanus* but differs with the female hind tibiae slender, under surface scarcely concave and anterior surface with hairs nearly simple, the male flagellum length (*urbanus* Fg:UID > 1.5; *forrestae* Fg:UID < 1.5) and male T1 punctation (*urbanus*, a sparsely punctures mesially; *forrestae*, closely punctate mesially). The female hind tibial characters also occur on species of *H.* (*Papualictus*) and *H.* (*Quasilictus*). However, I consider *Homalictus* proper the correct placement for *H. forrestae* as the hind tibial characters are the only characters shared, in both sexes, with the other two subgenera.

Homalictus (Homalictus) maitlandi (Cockerell)

Figures 7–9

Halictus maitlandi Cockerell, 1910: 223.
Homalictus maitlandi. — Michener, 1965: 180, 338. — Walker, 1986: 145.

Material examined. Holotype ♀ Qld, Cairns, Kuranda, Mar 1902, Turner (BMNH).

Other specimens examined: Qld. (6♀) same data as holotype; 1♀ Mossman Gorge (16°29′S, 145°16′E), Daintree Nat. Park, 26 Oct 1988, K. Walker (NMV); 1♀ McIlwraith Range, c. 510 m (13°45′S, 143°21′E), 22–27 Jul 1977, R.W. Taylor, in rain forest (ANIC); 1♀, 3 km ENE Mt Tozer (12°44′S, 143°14′E), 28 Jun–4 Jul 1986, J.C. Cardale, ex. Malaise trap (ANIC); 2♀ 11 km ENE Mt Tozer (12°43′S, 143°18′E), 11–16 Jul 1986, J.C. Cardale, ex. ethanol (ANIC); 1♂ Claudie River, 1 mi W Mt Lamond (12°43′S, 143°17′E), 19 Dec 1971, D.K. McAlpine, G.A. Holloway, D.P. Sands (AM).

Diagnosis. See Walker (1986).

Description of male. Body length: 6.16 mm; Forewing length: 1.48 mm; Head width: 1.62 mm. Relative head measurements: HW: 100; HL: 85; UID: 58; LID: 42; AOD: 15; IAD: 10; OAD: 28; IOD: 16; OOD: 16; CL: 22; GW: 16; EW: 31; SL: 34; FL: 142.

Structure. Head broad, inner orbits converging strongly below, eyes glabrous; median frontal carina absent; scape reaches anterior margin of median ocellus; clypeus convex, shining though covered with fine reticulate pattern. Frons smooth though covered with distinct tessellate pattern; vertex broad. Pronotum dorsolateral angles bluntly obtuse, well projected. Mesoscutum and scutellum smooth. Dorsal surface of propodeum not defined by carinae, smooth except weakly ruguloso-striolate along posterior margin. Metasomal terga impunctate and smooth. Fore and mid tarsal segments flanged laterally; hind basitibial plate complete, bluntly acute apically.

Colour. Body black except metasoma dark brown, anterior half of clypeus pale white-yellow, antennal scapes and pedicles red-brown, legs and coxae, trochanters and basal half of fore femora brown, remainder of legs light red-brown except tarsal segments pale white.

Vestiture. Body sparse except lower frons and paraocular areas with cover of adpressed, plumose hair, genae with dense cover of long, plumose hair forming a "beard"; anterolateral corners of mesoscutum, metanotum and lateral margins of propodeum with dense cover of long, plumose golden hair, posterior margin of mesoscutum with weak band of hair, fore coxae with some long, plumose hair, fore trochanters with dense cover of long, plumose hair, hair length exceeds length of femur; fore and mid tarsi with dense cover of simple and plumose hair, mid and hind femora almost glabrous.

Genitalia and associated sterna. (figs 7–9).

Distribution. Cape York Peninsula and north Queensland.

Remarks. Walker's (1986) comments on *H. maitlandi* were based on the only available material (types collected in 1902). Recently collected specimens confirm the species is extant and provide the male character suite described and figured here. Examination of the male genitalia characters affirms the placement of *maitlandi* within *Homalictus* and these characters, together with flanged tarsal segment characters, provide synapomorphies for the clade of *H. maitlandi*, *H. latitarsis* (Friese) and *H. grossopedalus* Walker.

Homalictus (Homalictus) pilosignya sp. nov.

Figures 10–12

Material examined. Holotype, ♀ Qld, McIlwraith Range, 30 km E of Coen (13°50′S, 143°17′E), 3 Nov 1988, K. Walker (NMV, T-16621).

Paratypes. 6♀ (NMV, T-16622-T-16627), 3♂ (NMV, T-16628-T-16630) same data as holotype.

Diagnosis. A member of the "*blackburni*" species-group; female with frons smooth,

pronotum dorsolateral angles obtuse, mesoscutum sparsely to openly punctate, dorsal surface of propodeum mesially coarsely ruguloso-striate, laterally striate; male with mesoscutum impunctate, dorsal surface of propodeum ruguloso-striolate, fore and mid leg tarsal segments laterally flanged, genal hairs long, fore leg trochanters with dense cover of long, plumose hair, lateral margins of fore tarsi with long hairs, branched on only the outer surface of the hair shaft.

Description of female. (measurements of holotype in bold) Body length: 5.62–5.69 mm; Forewing length: 1.41–**1.43** mm; Head width: 1.74–**1.79** mm. Relative head measurements: HW: 100; HL: 81–**83**; UID: 50–**52**; LID: 46–**47**; AOD: 17–**18**; IAD: **8**–09; OAD: **32**–33; IOD: 13–**14**; OOD: 12–**13**; CL: 17–**18**; GW: **15**–16; EW: 25–**26**; SL: **45**–46; FL: **82**–83.

Structure. Head broad, inner orbits converging below, median frontal carina absent; eyes with sparse cover of minute setae. Scape elongate, reaches at least posterior margin of median ocellus. Clypeus weakly convex in side view, anterior margin coarsely and irregularly indented, remainder of surface dull, covered with sparse, minute puncture, supraclypeal area impunctate. Frons, vertex and paraocular areas smooth, covered with a microtessellate pattern, sparsely punctate with piliferous punctures. Pronotum dorsolateral angles obtuse, weakly projected. Mesoscutum surface dull, covered with microtessellate pattern arranged as a circular pattern, openly to sparsely punctate with piliferous punctures. Scutellum sculpture similar to mesoscutum except close to openly punctate, scutellum length equal to length of dorsal surface of propodeum. Dorsal surface of propodeum not defined by carinae, sculpture mesially coarsely ruguloso-striate, laterally striate, sculpture reaches dorsal rim. Mesepisternum and metepisternum smooth, with fine reticulate pattern. Fore basitarsal outer apicolateral comb absent, hind basitibial plate apically obtuse, inner hind tibial spur coarsely serrate with 3 teeth.

Colour. Body black except antennal flagella brown, mesoscutum and scutellum sooty black, metasoma tergum 1 with dark blue hue, legs with tarsi brown.

Vestiture. Body sparse, except tomentose hair on pronotum mesodorsal and dorsolateral areas, mesoscutum anterolaterally and anterior spiracle cover, lateral margins of propodeum with long plumose hair; hind leg and ventral metasomal scopae as usual for the genus.

Description of male. Body length: 3.92–4.62 mm; Forewing length: 3.85–4.01 mm; Head width: 1.29–1.34 mm. Relative head measurements: HW: 100; HL: 80–82; UID: 55–56; LID: 34–36; AOD: 09–10; IAD: 11–12; OAD: 33–34; IOD: 15–16; OOD: 11–12; CL: 16–17; GW: 14–15; EW: 32–34; SL: 28–30; FL: 160–163.

Structure. Head broad, sculpture smooth, with a fine reticulate pattern, frons, clypeus and supraclypeal area impunctate; inner orbits converging strongly below; scape reaches well short of anterior margin of median ocellus. Pronotum dorsolateral angles broadly obtuse to rounded, weakly produced. Mesoscutum and scutellum dull, microtessellate, both impunctate. Dorsal surface of propodeum not defined by carinae, sculpture finely ruguloso-striolate, sculpture not reaching dorsal rim. Fore and mid leg tarsal segments laterally flanged.

Colour. Body black except antennal flagella suffused with dark brown; legs dark brown except tarsi light red-brown.

Vestiture. Body sparse except clypeus and lower paraocular areas with some erect, plumose hairs, genal hairs long, forming a "beard", fore leg trochanters with dense cover of long, plumose hair, mid trochanters with some plumose hair, though not as long or cover as dense as vestiture on fore trochanters, mesoventral area with moderate cover of simple hair; lateral margins of fore tarsi with long hairs, branched only on outer surface of hair shaft.

Genitalia and associated sterna. (figs 10–12).

Distribution. Cape York Peninsula and north Queensland.

Etymology. The epithet is from "*pilosus*" meaning hairy and "*ignya*" referring to the upper section of the leg.

Remarks. Homalictus pilosignya shares with *H. atrus* fore leg vestiture (coxae and trochanters with dense cover of long, plumose hair and lateral margins of fore tarsi with long, simple hairs) and the rasp-like sculpture on the apicoventral surface of the genitalia volsellae but differs in the female mesoscutum and scutellum colour (*pilosignya* sooty black; *atrus* black) and male vestiture (*pilosignya* with plumose vestiture on fore trochanters only (*atrus* plumose vestiture on fore leg trochanters and all coxae), plumose hair absent on the mesoventral area (*atrus* plumose hair present) and the hairs branched on one side only of the lateral margins of the fore tarsi (*atrus* hairs simple).

Homalictus pilosignya belongs to a species-group (termed "*blackburni*" by Walker (1986) for Australian species only and "*buccinus*" by Pauly (1986) for Australian and non-Australian species) which contains over 50 species that occur in India, Sri Lanka, VietNam, Thailand, Malaysia, Indonesia, Philippines, New Guinea, Bismark Archipelago, Caroline, Bismarck and Solomon Islands, the New Hebrides and Australia (Pauly (1986)). This species-group forms a monophyletic clade defined by several synapomorphies (both sexes with apex of marginal cell terminating on wing margin, female lacking fore basitarsal outer apicolateral comb absent, male with genal vestiture long (forming a "beard"), flanged tarsal segments, and coxae and/or trochanters with plumose and elongated vestiture). Australian members of this clade (*H. atrus*, *H. blackburni*, *H. cassiaefloris*, *H. dampieri*, *H. eurhodopus*, *H. grossopedalis*, *H. latitarsis*, *H. maitlandi* and *H. pilosignya* sp. nov.) occur throughout the "Torresian" faunal province as defined by Main (1981), with the greatest species diversity found in north Queensland and Cape York Peninsula.

Homalictus (Homalictus) verticulus sp. nov.

Figures 13–14

Material examined. Holotype. ♀ Northern Territory, 12 km NNE of Borroloola (15°58′S, 136°21′E), 1 Nov 1975, J.C. Cardale, on *Terminalia volucris* R.Br. ex Brenth. (ANIC).

Paratype. 1♀, NT, 22 km WSW of Borroloola (16°08′S, 136°06′E), 2 Nov 1975, J.C. Cardale, caught in malaise trap. (ANIC).

Diagnosis. A member of the "*urbanus*" species-group; female with frons striate, inner orbits parallel to weakly diverging below, vertex long and broad (IOD = vertex length), genae enlarged (GW 1.3 x EW), pronotum dorsolateral angles large and acute, mesoscutum posterior half closely punctate except parapsidal areas densely punctate, dorsal surface of propodeum striate with several basal interconnectives.

Description of female. (measurements of holotype in bold) Body length: 4.85–**5.01** mm; Forewing length: 1.05–**1.06** mm; Head width: 1.53–**1.65** mm. Relative head measurements: HW: 100; HL: **80**–81; UID: **61**–62; LID: **62**; AOD: **22**–23; IAD: **9**–10; OAD: **35**; IOD: **17**–18; OOD: **18**–19; CL: **15**–16; GW: **26**–27; EW: **20**; SL: **39**–40; FL: **72**–74.

Structure. Head broad (fig. 13), inner orbits parallel to weakly diverging (in holotype) below, median frontal present, extends less than half-way to median ocellus; eyes with sparse cover of minute setae. Scape not reaching anterior margin of median ocellus. Clypeus flat in side view, anterior margin straight, surface dull, anterior half with densely punctate with large, shallow punctures, remainder openly punctate with small puncture, supraclypeal area impunctate. Frons striate to level of anterior margin of lateral ocelli, areas lateral to median ocelli smooth, vertex long and broad (IOD = vertex length), striate, striae continue onto enlarged genae (fig. 14). Labrum basal area with 2 large tubercles on either side of midline. Pronotum dorsolateral angles large and acute. Mesoscutum surface dull, covered with a fine reticulate pattern, impunctate to sparsely punctate, remainder closely punctate except parapsidal areas densely punctate. Scutellum shining, sparely to openly punctate, scutellum length longer than length of dorsal surface of propodeum. Dorsal surface of propodeum not defined by carinae, dorsal rim rounded and shining, sculpture striate with several interconnectives basally, lateral striae continue onto vertical surface. Mesepisternum and metepisternum coarsely striate. Hind basitibial plate apically rounded, inner hind tibial spur coarsely serrate with 3 large teeth.

Colour. Head dark blue/green, antennae brown, mandible amber, mesoscutum semi-metallic blue/green, scutellum blue, propodeum and metasoma black, legs brown.

Vestiture. Body sparse, except tomentose hair on pronotum dorsolateral areas, and mesoscutum anterolaterally, lateral margins of propodeum with long plumose hair; hind leg and ventral metasomal scopae as usual for the genus.

Distribution. Borroloola region, Northern Territory.

Etymology. The epithet is from "*vertex*", meaning top, and refers to the unusual nature of the vertex.

Remarks. Homalictus verticulus shares enlarged head characters with *H. ctenander* Michener but differs markedly in head, mesoscutum and propodeum sculpture patterns and body colour. It is most like *H. holochlorus* (Cockerell) in head sculpture characteristics, body size and colour but differs in the female by enlarged vertex and genae, prominent pronotum dorsolateral angles (acute distally), mesoscutum punctation (*verticulus*, mesially closely punctate, parapsidal areas densely punctate; *holochlorus* mesially openly punctate, parapsidal areas closely punctate) and sculpture on the propodeum (*verticulus*, striate; *holochlorus*, ruguloso-striolate).

Subgenus *Papualictus*

Homalictus (*Papualictus*) Michener, 1980: 8. Type species: *Homalictus megalochilus* Michener, 1980: 8 (by original designation) = *Homalictus lorentzi* (Friese), synonymy by Pauly (1986).

Diagnosis revised from Michener (1980). Both sexes with frons, vertex and genal area coarsely striate; frontal carina present between antennal bases; females with hind tibiae slender, not scarcely concave beneath, with hair of outer surface sparse and simple; males with head much broader than long (HW at least 1.2 x HL), clypeus low and transverse, about five times as wide as long, apical truncation concave, epistomal suture lateral to tentorial pit horizontal, mandibles enlarged and sickle shaped, shifted slightly posteriorly so that a triangular malar space is formed, pre-episternum elevated to form a rough vertical ridge.

Homalictus (Papualictus) megagnathus sp. nov.

Figures 15–19

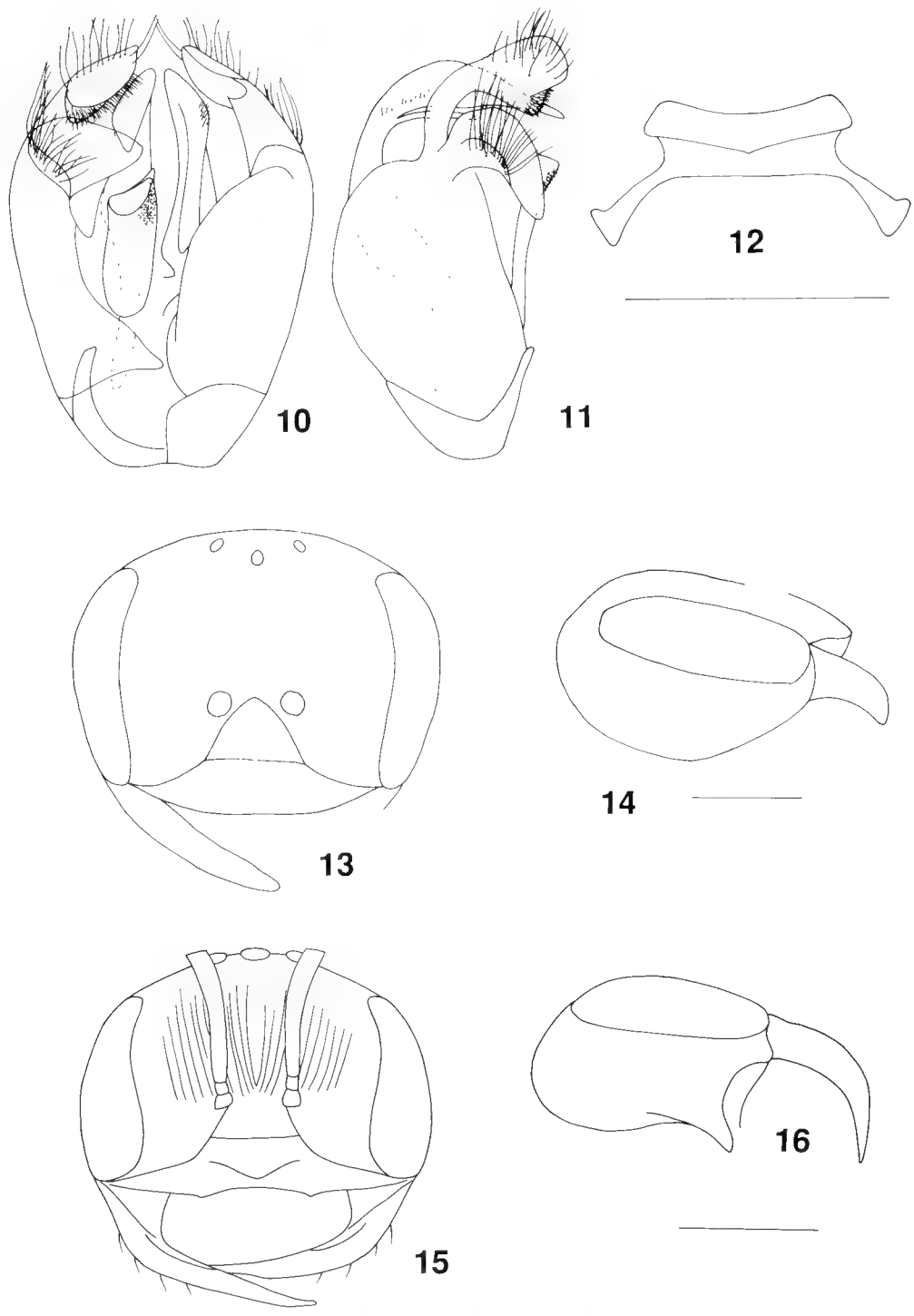
Material examined. Holotype. ♂, Qld, Mt Webb Nat. Pk (15°04′S, 145°07′E), 27–30 Apr 1981, I.D. Naumann (ANIC; Genitalia removed and placed in vial on pin).

Paratypes. Qld: 1♂, 9 km ENE Mt Tozer (12°43′S, 143°17′E), 5–10 Jul 1986, J.C. Cardale, at MV light (ANIC); 1♀ 3km ENE Mt Tozer (12°44′S, 143°14′E), 28 Jun-4 Jul 1986, J.C. Cardale, ex. Malaise trap/ethanol (ANIC).

Diagnosis. Female with frons, vertex and genae coarsely striate, anterior surface of hind tibia with hairs nearly simple, bristlelike or with 1 or 2 branches (no area with abundant, short, erect, plumose hairs as is usual for the genus); hind tibiae slender, under surface scarcely concave; male with head broader than long, clypeus short and transverse, apical truncation concave, anteromesial margin elevated as a large boss, underneath boss clypeus strongly concave, mandibles elongated and sickle shaped, shifted posteriorly; each gena with a large lamella-shaped process.

Description of male. (measurements of holotype in bold) Body length: 3.93–**4.24** mm; Forewing length: 0.66–**0.68** mm; Head width: 1.27–**1.29** mm. Relative head measurements: HW: 100; HL: **70**–72; UID: 62–**64**; LID: 61–**62**; AOD: **20**–21; IAD: 11–**12**; OAD: 31–**32**; IOD: 16–**18**; OOD: **20**–21; CL: **10**–12; CW: **54**–56; GW: **21**–22; EW: 23–**24**; SL: 37–**38**; FL: 92–**94**; ML: **62**–64.

Structure. Head broader than long (fig. 15), inner orbits weakly converging below to almost parallel below, median frontal carina well developed, reaches half way to median ocellus. Clypeus smooth and shining, short and transverse, almost all of clypeus positioned above lower margins of eyes, apical truncation concave, only about one-fifth as wide as clypeus, anteromesial margin elevated as a large, rounded, forwardly projected rounded smooth shining boss, underneath boss clypeus strongly concave, epistomal suture lateral to tentorial pit horizontal. Supraclypeal area weakly elevated, covered with a fine reticulate pattern. Frons coarsely striate above antennal bases, sculpture continues to level of anterior margin of lateral ocelli, laterally continues almost to inner margin of eye. Mandibles shifted posteriorly so that anterior articulation is well behind lower inner margins of eyes, posterior articulation of mandibles shifted posteriorly to well behind lower outer margins of eyes, the shifted posterior mandibular articulation forms a small triangular malar space; mandibles elongated and sickle-shaped, longer than lower interorbital distance, apex of mandible rounded and weakly upturned, pollex absent. Labrum with rounded boss across the entire basal area, distally labrum rounded. Genal width, in side view, subequal to eye width, each gena with a single large, transversely broad, lamella-shaped process (fig. 16), processes originate on underside of genae slightly behind level of posterior mandibular articulation. Vertex broad and striate, slightly wider than interocellar distance. Pronotum dorsolaterally rounded, in side view lateral margin with distinct carina extending to dorsolateral angle. Pre-episternum, forward of pre-episternal groove, elevated to form rough vertical ridge; mesepisternum, above pleural signum, rounded and smooth; venter of mesepisternum without transverse ridge behind front coxae. Mesoscutum anterolateral margins raised forming a lip, mesially lip absent, anteriorly dull and impunctate, covered with a fine reticulate pattern, mesially and laterally shining though mesial area finely striate and openly punctate, parapsidal areas with a fine broadly reticulate pattern, sparsely punctate. Scutellum smooth and highly polished, sparsely punctate with minute punctures. Dorsal surface of propodeum not defined by carinae, smooth and polished except a few weak, short striae basally. Metasomal T1 highly polished and impunctate except for a few minute punctures, T2-T5 shining and impunctate except basally each tergite with several weak transverse lines. Fore basitarsal comb fan shaped; hind basitibial plate weakly present and apically acute.



Figures 10–16. *Homalictus* spp. *H. pilosignya* (paratype): male genitalia, fig. 10, ventral view (left half) and dorsal view (right half); fig. 11, lateral view; fig. 12, metasomal S7 and S8. *H. verticulus* (holotype): figs 13–14, head front and lateral views respectively. *H. megagnathus* (holotype): figs 15–16, head front and lateral views respectively. Scale lines (associated with each species) = 0.5 mm.

Colour. Body black except, clypeus, mandibles, antennal scapes and legs light red-brown, coxae black, femora suffused with dark brown, antennal flagellum brown.

Vestiture. Body sparse, frons and mesoscutum with sparse cover of erect hair, lower paraocular areas with similar, though adpressed, hair, metasomal sternites with sparse cover of erect long and short plumose hair.

Genitalia and associated sterna. (figs 17–19).

Description of female. Body length: 4.47 mm; Forewing length: 1.08 mm; Head width: 1.36 mm. Relative head measurements: HW: 100; HL: 82; UID: 58; LID: 52; AOD: 18; IAD: 09; OAD: 34; IOD: 16; OOD: 16; CL: 18; GW: 14; EW: 26; SL: 42; FL: 82; ML: 36.

Structure. Agrees with description of male except as follows: Head with inner orbits converging below. Clypeus convex, sculpture openly punctate with shallow punctures, surface dull, covered with fine reticulate pattern except anterior margin smooth and shining. Supraclypeal area sculpture and punctation as on clypeus. Frons coarsely striate above antennal bases, ridges more prominent than in male. Mandibles less shifted posteriorly relative to eye than in male, malar area short, mandibles of ordinary size and form. Genal width, in side view, less than eye width, sculpture striate. Vertex striate, slightly narrower than interocellar distance. Pronotum dorsolateral angle acute, in side view lateral margin of pronotum with a ridge extending to dorsolateral angle, ridge less prominent than in male. Pre-episternum, forward of pre-episternal groove, weakly elevated to form a vertical ridge. Mesoscutum anterolateral margins as in male, surface dull, covered with a fine reticulate pattern, sculpture mesially closely punctate, in parapsidal areas openly punctate. Scutellum surface dull as on mesoscutum, sculpture openly to sparsely punctate. Dorsal surface of propodeum as in male except basal striae rugulose. Metasomal tergites as in male. Hind basitibial plate well developed, apically acute. Anterior surface of hind tibia with hairs nearly simple, bristlelike or with 1 or 2 branches (no area with abundant, short, erect, plumose hairs as is usual for the genus); hind tibiae slender, under surface scarcely concave. Inner margin of inner hind tibial spur with 2 or 3 apically rounded teeth.

Colour. As in male but with antennal scapes and flagella light red-brown infuscated with dark brown, mesoscutum dull coppery-green, scutellum with blue hue.

Vestiture. As in male but with metanotum with tomentum of short white hair; femoral and sternal scopa well developed, similar colour to legs.

Distribution. Cape York Peninsula and north Queensland.

Etymology. The epithet is from "*mega*" and "*gnathos*" and refers to the enlarged mandibles.

Remarks. Homalictus (*Papualictus*) was erected for five species found in the moderate to high altitudes of New Guinea, New Britain and New Ireland (Michener, 1980). The discovery of *H. megagnathus* now extends its distribution into northern-east Australia. Michener produced a diagnosis for *H.* (*Papualictus*) but noted that since males were not known for all described species, the male diagnostic characters "may not all actually be subgeneric attributes" (p. 8). Comparisons between the diagnostic characters of *H.* (*Papualictus*) and character states of *H. megagnathus* revealed the following differences. Body length was described as large for both sexes in *H.* (*Papualictus*), but *H. megagnathus* is best termed small (♀: 8.5–11 mm, 10–11 mm; ♀ & ♂ < 4.5 mm, respectively). Body length is the only variable female subgeneric character. Male subgeneric characters differ as: Head ratio (width 1.2 × length; width 1.4 × length respectively); genal width (GW 2 × EW; GW almost equal to EW, respectively); pronotum dorsolateral angle large and distally acute versus small and rounded; and the following two characters do not occur on *H. megagnathus*: mesepisternum, above pleural signum, elevated to form a rough prominence; and dorsal surface of propodeum strongly elevated to form a shining, longitudinally elongate boss.

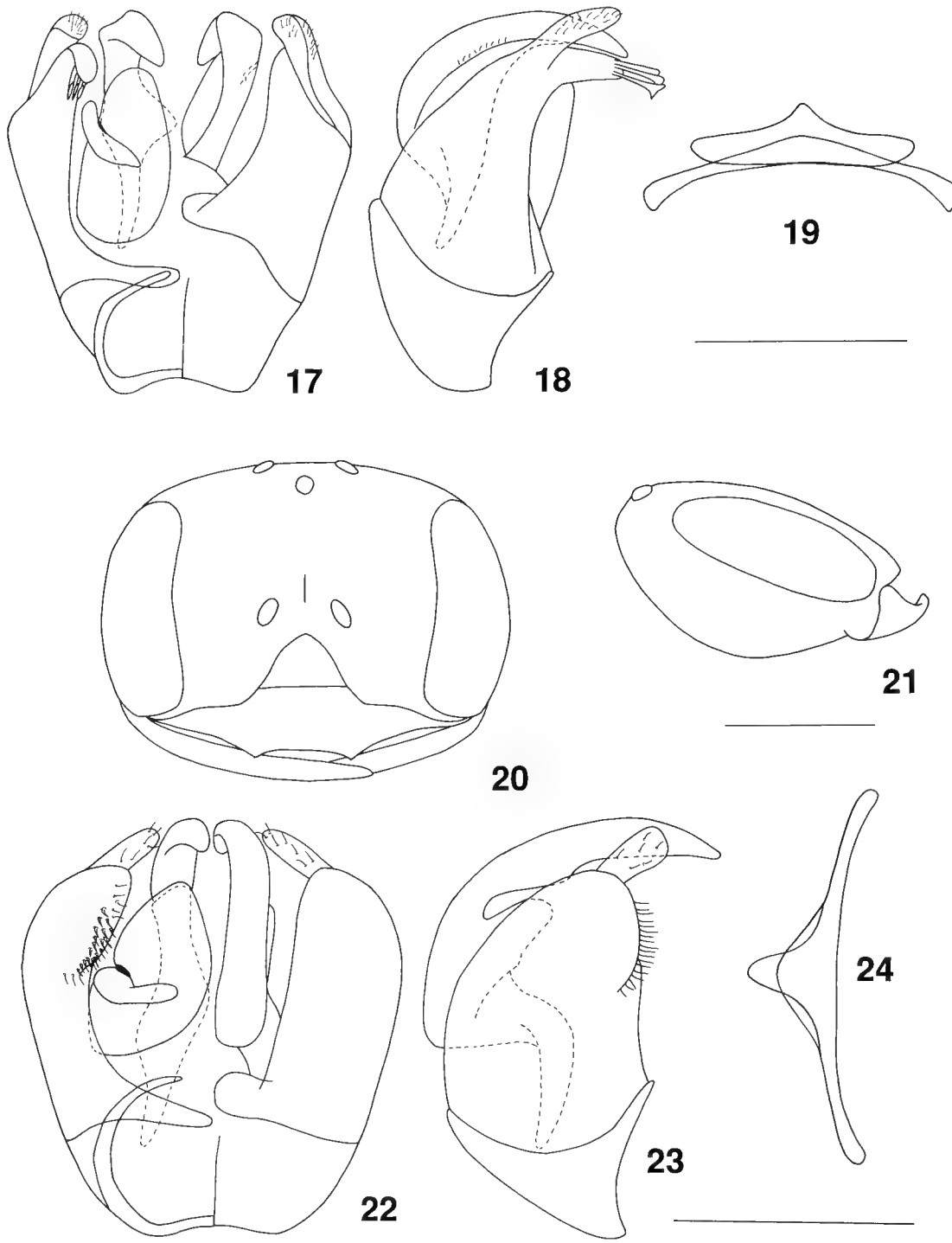
Subgeneric placement not resolved

Homalictus sicarius sp. nov.

Figures 20–24

Material examined. Holotype. ♂, Qld, 11 km NW of Bald Hill, Mcllwraith Range (13°44′S, 143°20′E), 26 Jun–13 Jul, I.D. Naumann, at light, search party campsite (ANIC; genitalia removed and placed in vial on pin).

Diagnosis. Male with head and vertex broad (HW 1.5 × HL; vertex width 0.8 × IOD), median frontal carina present, clypeus low and transverse (CW 4.5 × CL), anteromesial margin concave, epistomal suture lateral to tentorial pit horizontal, frons weakly striate, genae area and vertex smooth, mandibles elongated (ML 0.9 ×



Figures 17–24. *Homalictus* spp. *H. megagnathus* (holotype): male genitalia, fig. 17, ventral view (left half), dorsal view (right half); fig. 18, lateral view; fig. 19, metasomal S7 and S8. *H. sicarius* (holotype): figs 20–21, head, front and lateral views respectively. Male genitalia: fig. 22, ventral view (left half) and dorsal view (right half); fig. 23, lateral view; fig. 24, metasomal S7 and S8. Scale lines (associated with each species) = 0.5 mm except figs 22–24 = 0.25mm.

LID), shifted posteriorly so that forming a small triangular malar space, GW subequal EW, pronotum dorsolateral angles obtuse, mesoscutum impunctate, dorsal surface of propodeum smooth.

Description of male. (female unknown) (measurements of holotype in bold). Body length: **4.16** mm; Forewing length: **0.96** mm; Head width: **1.25** mm. Relative head measurements: HW: 100; HL: **74**; UID: **62**; LID: **60**; AOD: **18**; IAD: **14**; OAD: **30**; IOD: **18**; OOD: **18**; CL: **15**; CW: **68**; GW: **22**; EW: **24**; SL: **38**; FL: **116**; ML: **56**.

Structure. Head broader than long (figs 20–21), inner orbits weakly converging below, median frontal carina present, reaches one third to median ocellus. Clypeus with a dull sheen, covered with a fine reticulate pattern, impunctate, short and transverse (CW 4.5 × CL), almost half of clypeus positioned above lower margins of eyes, apical margin not truncate though anteromesial margin concave with lateral points forming small processes, epistomal suture lateral to tentorial pit horizontal. Supraclypeal area weakly elevated, covered with a fine reticulate pattern. Frons appears smooth though with weak striae above antennal bases, striae not reaching anterior margin of lateral ocelli, lateral margin smooth. Mandibles shifted posteriorly so that anterior articulation is behind lower inner margins of eyes, posterior articulation of mandibles shifted posteriorly to well behind lower outer margins of eyes, the shifted posterior mandibular articulation forms a small triangular malar space (fig. 21); mandibles elongate, weakly sickle-shaped, almost as long as lower interorbital distance, apex of mandible rounded, pollex absent. Genal width, in side view, subequal to eye width. Vertex broad (Vertex width 0.8 × IOD) and smooth. Pronotum dorsolateral angles obtuse, in side view weakly elevated. Pre-episternum, forward of pre-episternal groove, not elevated to form rough vertical ridge; mesepisternum, above pleural signum, rounded and smooth; venter of mesepisternum without transverse ridge behind front coxae. Mesoscutum anterior margin rounded, entire surface dull and impunctate, covered with a fine reticulate pattern. Scutellum smooth, polished and impunctate. Dorsal surface of propodeum not defined by carinae, smooth and polished except a few weak, short striae basally. Metasomal terga polished and impunctate. Fore basitarsal comb fan shaped; hind basitibial plate well developed, apically acute.

Colour. Body black except, apical half of clypeus with metallic blue/red tinge, mandibles and basal one quarter of antennal scapes amber, antennal flagellar segment brown, coxae and femora brown, tibiae and tibiae and tarsi light red-brown suffused with dark brown.

Vestiture. Body sparse, frons and mesoscutum with sparse cover of erect hair, lower paraocular areas and clypeus with moderate cover of short plumose hair, metasomal sternites with sparse cover of erect long and short plumose hair.

Genitalia and associated sterna. (figs 22–24).

Distribution. Cape York Peninsula.

Etymology. The epithet is from "*sica*" meaning dagger and refers to the shape of the mandibles.

Remarks. Subgeneric placement of *H. sicarius* will require association of the female and examination of the full character suite. Several character states of the male suggest subgeneric placement in *H.* (*Papualictus*). In particular the head ratio (HW 1.4 × HL), clypeus low and transverse (clypeus width 4 × CL), anteromesial margin concave, mandibles elongated, weakly sickle-shaped and with the posterior articulation slightly shifted posteriorly to form a small triangular malar space. However, comparison with my diagnosis of *H.* (*Papualictus*) (Walker, 1986) highlighted the following differences: frons, vertex and genae not striate, the clypeus apical margin not truncate and concave beneath, not forming an elevated boss, mandible length less than LID and pre-episternum not elevated to form a rough vertical ridge. I considered this single male specimen warranted description to flag a second Australian species that possesses a number of subgeneric male head characters of *H.* (*Papualictus*) and may eventually be placed in that subgenus.

Acknowledgments

I wish to thank the curators of the institutions listed for the loan of their specimens and Professor C.D. Michener, Drs Glynn Maynard and Gary Poore for their constructive comments.

References

Cockerell, T.D.A., 1910. New and little known bees. *Transactions of the American Entomological Society* 36: 199–249.

Cockerell, T.D.A., 1915. Descriptions and records of bees — LXX. *Annals and Magazine of Natural History* (8)16: 482–489.

Cockerell, T.D.A., 1919. The metallic-coloured halictine bees of the Philippine Islands. *Philippine Journal of Science* 15: 11–13.

Harris, R.A., 1979. A glossary of surface sculpturing. *Occasional Papers in Entomology, State of California Department of Food and Agriculture* 28: 1–31.

Kirby, W.F., 1900. Hymenoptera. In: Andrews, C. (ed.), *A monograph of Christmas Island: physical features and geology.* London.

Main, B.Y., 1981. A comparative account of the biogeography of terrestrial invertebrates in Australia: some generalizations. Pp. 1057–1077 in: Keast, A., (ed.), *Ecological biogeography of Australia.* Vol. 2. Dr W. Junk: The Hague.

Michener, C.D., 1965. A classification of the bees of the Australian and south Pacific regions. *Bulletin of the American Museum of Natural History* 130: 1–362, 15 pls.

Michener, C.D., 1978. The classification of halictine bees: tribes and Old World nonparasitic genera with strong venation. *University of Kansas Science Bulletin* 51(16): 501–538.

Michener, C.D., 1980. The large species of *Homalictus* and related Halictinae from the New Guinea area (Hymenoptera, Apoidea). *American Museum Novitates* 2693: 1–21.

Pauly, A., 1986. Les abeilles de la sous-famille des Halictinae en Nouvelle-Guinée et dans l'Archipel Bismark (Hymenoptera: Apoidea: Halictidae). *Zoologische Verhandelingen* 227: 1–58.

Walker, K.L., 1986. Revision of the Australian species of the genus *Homalictus* (Hymenoptera: Halictidae). *Memoirs of the Museum of Victoria* 47(2): 105–200.

Memoirs of the Museum of Victoria 56(1):83–89 (1997)

DESCRIPTIONS OF NEW LEPTOPHLEBIIDAE (INSECTA: EPHEMEROPTERA) FROM AUSTRALIA. I. *TILLYARDOPHLEBIA* GEN. NOV.

JOHN C. DEAN

Environment Protection Authority, Catchment and Marine Studies,
27 Francis Street, Melbourne, Vic. 3000, Australia

Abstract

Dean, J.C., 1997. Descriptions of new leptophlebiidae (Insecta: Ephemeroptera) from Australia. I. *Tillyardophlebia* gen. nov. *Memoirs of the Museum of Victoria* 56: 83–89.

The genus *Tillyardophlebia* gen. nov. is established to accommodate a group of leptophlebiid mayflies from eastern Australia. Adults and nymphs of *T.rufosa* sp. nov. from Victoria and New South Wales and *T.alpina* sp. nov. from New South Wales are described and figured.

Introduction

The family Leptophlebiidae is the dominant mayfly family in Australia. Despite recent descriptions of new genera (Dean, 1987, 1988; Campbell and Suter, 1988; Campbell, 1993), the family remains poorly known, with many undescribed genera held in various collections (Dean and Suter,1996). The present paper is the first in a series, and describes a new genus and two new species from south-eastern Australia. Additional taxa will be described as nymphs are associated with adults and sufficient adult material becomes available. Examined material has been preserved in alcohol, with parts of some specimens mounted on microscope slides. All material is lodged in the Museum of Victoria (NMV).

Tillyardophlebia gen. nov.

Diagnosis. Imago. Forewing with membrane hyaline (Fig. 1); costal and subcostal cells either uniformly washed with reddish-brown or hyaline with cells in apical third of wing translucent, whitish. Length-width ratio 2.8–3.0. 4–9 costal crossveins basal to the bulla, 10–19 distal to the bulla. MA forked at 0.38–0.41 wing length. MP_2 attached by crossvein to MP_1 at 0.17–0.18 wing length. ICu_1 not linked to CuA-CuP crossvein ; base of ICu_1 linked by crossvein to CuA; ICu_1 and ICu_2 moderately diverging as wing margin approached. Hindwing 0.24–0.28 length of forewing. Costal margin with shallow concavity just beyond midlength, costal space relatively broad both basal and distal to this (Fig. 2). Vein Sc joining costal margin at about 0.95 wing length. Hindwing with 8–13 costal crossveins and 8–10 subcostal crossveins. All legs with tarsal claws dissimilar, one with an apical hook and opposing ventral flange, the other obtuse, pad-like (Fig. 6). Forelegs of male with ratios of segment lengths 0.71–0.89:1.00 (3.6–3.9 mm):0.04–0.05:0.37–0.43:0.37–0.45:0.28–0.36:0.10–0.11. Male genitalia with claspers 3-segmented, narrowing abruptly at about midlength (Fig. 4). Penes long, narrow, widely separated for most of length, fused at base only; with pair of stout, curved ventral spines a little basal to where the penes fuse (Figs 21, 22, 24, 25). Female ninth sternum with apical margin either flattened or very shallowly concave (Fig. 5).

Subimago. Wings uniformly yellowish-brown.

Mature nymph. Head prognathous, antennae about twice width of head. Mouthparts as in Figures 14–20. Clypeus with lateral margins slightly diverging to anterior. Labrum 1.1–1.4 times broader than clypeus; width 1.8–2.3 times maximum length; 2 setal fringes close to anterior margin, each fringe extending across more than half width of labrum; anterior margin with central notch, the base of which is concealed by frontal setal fringe, which lies along an overhanging canopy. Mandible with outer margin rounded, dense tuft of long setae at midlength, and series of shorter setae along margin between tuft and outer incisor; incisors slender, with 1 or more subapical denticles; prostheca large. Lingua of hypopharynx with well developed lateral processes, anterior margin with deep incision; superlingua with dense setal fringe along anterior margin. Maxilla somewhat squat, subapical row of about 25 pectinate setae; palp moderately short, terminal segment about same length as middle segment, middle segment bearing simple setae only. Labium with glossae not turned under ventrally, lying in same plane as paraglossae; palp 3-segmented, terminal segment about half length of middle segment. Legs relatively large, apex of hind femur reaching beyond midlength of abdomen (Fig. 7); all

segments of leg with fringe of setae along outer margin (Fig. 9); tarsal claws with ventral teeth, progressively larger apically (Fig. 10). Abdominal segments without setae on lateral margins, strongly developed posterolateral spines on segments 2–9 (Fig. 8); posterior margins of abdominal terga with series of stout spines, longer spines interspersed with shorter (Fig. 11). Gills present on abdominal segments 1–7, each gill lanceolate, with upper and lower lamellae equally developed (Fig. 12). Caudal filaments with apical whorl of stout spines on each segment, fine setae sparse (Fig. 13).

Type species. Tillyardophlebia rufosa sp. nov.

Etymology. The genus is named for R.J.Tillyard, in recognition of his pioneering work on Australian mayflies.

Remarks. Brief descriptions of *Tillyardophlebia* have previously been provided by Dean and Suter (1996) under the designation 'Genus D'. More species than those described below are known from Tasmania, Victoria and Queensland, but a shortage of material precludes their description in the present work.

The genus *Tillyardophlebia* can be distinguished from all other leptophlebiid genera by the following combination of characters.

Imago: 1, forewing with ICu_1 not attached to CuA-CuP crossvein; 2, forewing approximately 4 times length of hindwing; 3, hindwing with Sc joining wing margin at about 0.95 wing length; 4, tarsal claws dissimilar; 5, male genitalia with penes long, narrow, fused near base only, with a pair of stout ventral spines near base; 6, ninth sternum of female with apex either flattened or with very shallow concavity.

Nymph. 1, labrum slightly broader than clypeus and with notch in anterior margin; 2, width of labrum 1.8–2.3 times maximum length; 3, tarsal claws with ventral teeth; 4, abdominal segments without lateral fringe of setae; 5, posterolateral spines present on abdominal segments 2–9.

Tillyardophlebia is a member of the *Meridialaris* lineage as defined by Pescador and Peters (1980), which also includes the Australian genus *Austrophlebioides*. While the two Australian genera are closely related, *Tillyardophlebia* is clearly distinguished by the form of the male genitalia and, in the nymph, by the form of the labrum and the absence of setae on the lateral margins of the abdominal segments.

Keys to described species of *Tillyardophlebia*

Imagos

1. Legs with all segments yellow, brown pigmentation restricted to small area around apices of femora; male genitalia with ventral, triangular flange at about mid length of each penis lobe (Figs 21 22) ..... *Tillyardophlebia rufosa*

— Legs with femora dark brown, all other segments pale brown; male genitalia without ventral flange at mid length of each penis lobe (Figs 24 25) ..... *Tillyardophlebia alpina*

Nymphs

1 Gills with membranes heavily pigmented, purple; femora of all legs dark reddish-brown ..... *Tillyardophlebia alpina*

— Gills with membranes pale, yellow-white; femora of all legs light brown with several contrasting pale patches ..... *Tillyardophlebia rufosa*

Tillyardophlebia rufosa sp. nov.

Figures 1–23

Type material. Holotype: Victoria, Badger Creek, d/s weir, 23 Feb 1984, J. Dean, NMV T-16709, male imago reared from nymph.

Paratypes: same location, 31 Jan 1985, J. Dean, NMV T-16710, male imago reared from nymph; same location, 21 Feb 1980, J. Dean, NMV T-16711, male imago reared from nymph (wings, genitalia, legs, assorted nymphal parts mounted on slides); same location, 20 Mar 1980, J. Dean, NMV T-16712, female imago reared from nymph; same location, 21 Feb 1980, J. Dean, NMV T-16713, female imago reared from nymph (wings, ninth sternum, legs, assorted nymphal parts mounted on slides).

Other material examined. Vic. Badger Creek, d/s weir, various dates, J. Dean, 14 nymphs; same location, various dates, J. Dean, 5 female subimagos reared from nymphs; Watts River, Fernshaw, 4 Mar 1976, J. Dean, female imago reared from nymph; same location, 24 Feb 1977, J. Dean, 1 nymph; O'Shannassy River, u/s reservoir, 17 Feb 1977, J.Dean, 1 nymph; Thomson River, u/s Easton Portal, 22 Jan 1975, J.Dean, 1 nymph. NSW. Thredbo River, 1.5 km u/s Deadhorse Gap, 21 Jan 1984, J. Dean, 2 nymphs; Leather Barrel Creek, Alpine Way, 6 Feb 1985, J. Dean, 3 nymphs.

Description. Imago. Length of male: body 10.6–11.6 mm, forewing 10.0–10.3 mm; Length of female: body 11.7 mm, forewing 11.7 mm. Upper lobes of male eyes orange-brown, in contact dorsally. Thorax golden. Legs with all segments yellowish, apex of femur brown. Forewings with costal and subcostal cells washed with reddish-brown (Fig. 1). Male abdomen predominantly paler brown, with pair of thin, dark brown, longitudinal stripes along midline, an adjacent paler macula on each side of midline close to anterior margin, and further lateral to this an area of dark brown pigmentation (Fig. 23). Female abdomen similar, although with pale maculae less obvious and darker anterolateral region less contrasting with the rest of the segment. Penes lobes with ventral, triangular flange at about midlength, and triangular ventral process immediately distal to the fused basal section (Figs 21 22).

Subimago. Wings yellowish-brown, forewing costal and subcostal cells with brown pigmentation of imago showing through. Female abdomen reddish-brown.

Nymph. Labrum width 2.0–2.1 times maximum length; width of frontal setal fringe 0.5–0.6 times width of labrum, narrower than secondary fringe; anterior notch broad (Fig. 14). Femora with upper surface contrasting pale brown and yellow (Fig. 9). Gills with membrane pale, yellow-white. Abdominal terga contrasting brown and yellow colour pattern (Fig. 7).

Comments. Association of adult and nymph by rearing. Nymphs occur in small to medium sized forest streams, where they have been collected from the surface of large cobbles and small boulders in moderate currents.

Tillyardophlebia alpina sp. nov.

Figures 24–26

Type material: Holotype: New South Wales. Ramshead Creek, the Cascades, Merritt's Track, 27 Jan 1984, J. Dean, NMV T-16714, male imago. Paratype: same location and date, NMV T-16715, female subimago.

Other material examined: NSW. Ramshead creek, The Cascades, Merritt's track, 27 Jan 1984, J. Dean, 2 nymphs; Ramshead creek, u/s Mt Kosciusko summit track, 27 Jan 1984, J. Dean, 6 nymphs; Lake Cootapatamba, 24 Jan 1984, J. Dean, 1 nymph; Lake Albina inflowing stream, 9 Feb 1985, J. Dean, 24 nymphs; creek near top of Crackenback chair lift, 15 Dec 1978, J. Dean, 6 nymphs.

Description. Imago. Length of male, body 12 mm, forewing 11 mm. Upper lobes of male eyes pinkish-tan, in contact on meson of head. Thorax golden. All legs with femur dark brown, other segments pale brown. Forewings with costal and subcostal cells washed with pale brown. Abdomen predominantly darker brown, somewhat blotchy, each segment paler in posterior half; terga with thin, dark brown, longitudinal stripes along the midline, ill defined pair of paler maculae near anterior margin, 1 on either side of the midline (Fig. 26). Penes lobes without ventral flange at midlength; inner margin of each lobe with ventral process immediately distal to fused basal section (Figs 24, 25). Lobes in ventral view relatively long and narrow.

Subimago. Wings yellowish-brown.

Nymph. Labrum width about 2.2 times maximum length; width of frontal setal fringe 0.5–0.6 times width of labrum, narrower than secondary fringe; anterior notch narrow. Femora with upper surface strongly pigmented, reddish-brown. Gills with membrane darkly pigmented, purplish. Abdominal terga uniformly dark reddish-brown.

Comment. Association of adult and nymph is based on dissection of the male genitalia from a ripe nymph. The species is known only from the Kosciusko region, and nymphs have been collected from stony substrates of small streams, both above and just below the treeline.

Acknowledgments

Dr Ken Walker, Curator of Entomology, Museum of Victoria, is thanked for making available material held in the collections of the museum. Part of the work on the immatures has been funded by the Land and Water Resources Research and Development Corporation as an MRHI R and D project.

References

Campbell, I.C., 1993. A new genus and species of leptophlebiid mayfly (Ephemeroptera: Leptophlebiidae: Atalophlebiinae) from tropical Australia. *Aquatic Insects* 15: 159–167.

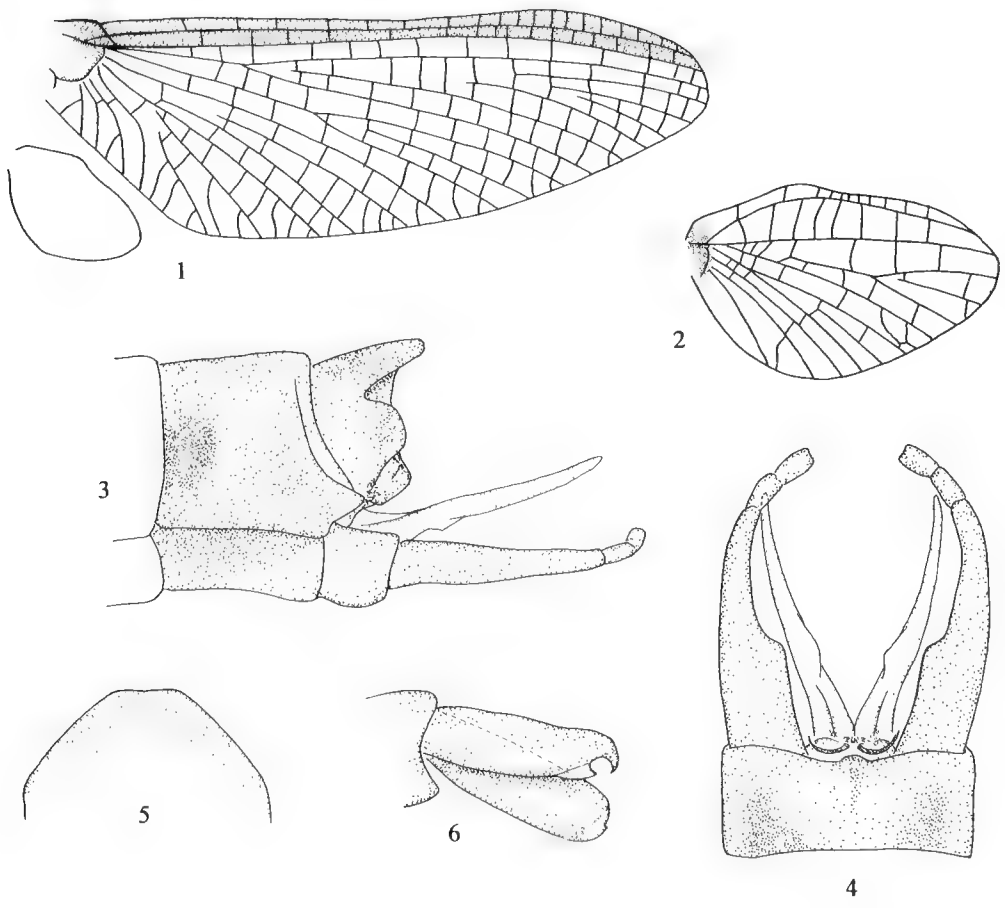
Campbell, I.C. and Suter, P.J., 1988. Three new genera, a new subgenus and a new species of Leptophlebiidae (Ephemeroptera) from Australia. *Journal of the Australian Entomological Society* 27: 259–273.

Dean, J.C., 1987. Two new genera of Leptophlebiidae (Insecta: Ephemeroptera) from south-western Australia. *Memoirs of the Museum of Victoria* 48: 91–100.

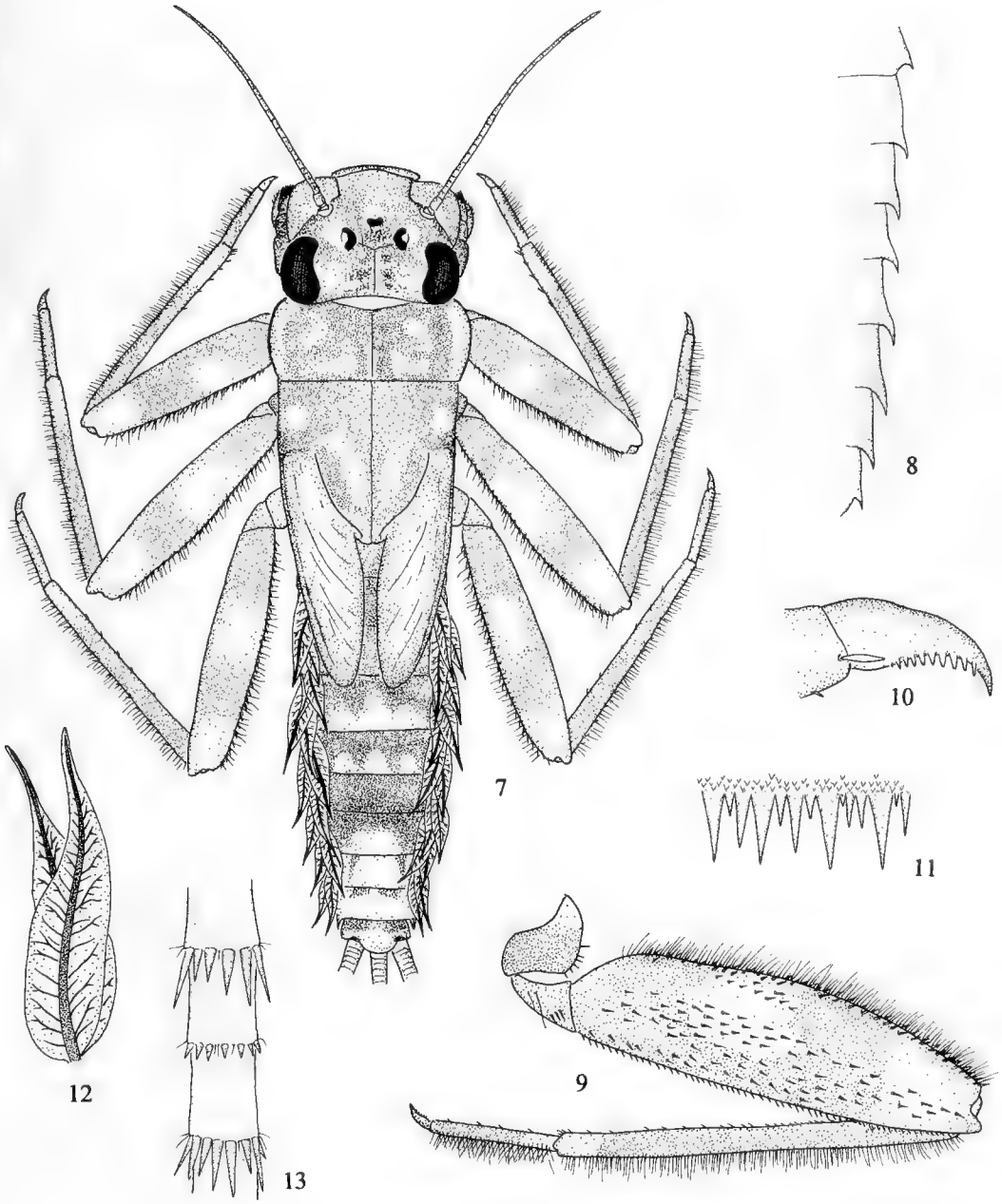
Dean, J.C., 1988. Description of a new genus of leptophlebiid mayfly from Australia (Ephemeroptera: Leptophlebiidae: Atalophlebiinae). *Proceedings of the Royal Society of Victoria* 100: 39–45.

Dean, J.C. and Suter, P.J., 1996. Mayfly nymphs of Australia. A guide to genera. *Identification Guide No.7, Co-operative research Centre for Freshwater Ecology*. Murray-Darling Freshwater Research Centre: Albury, New South Wales.

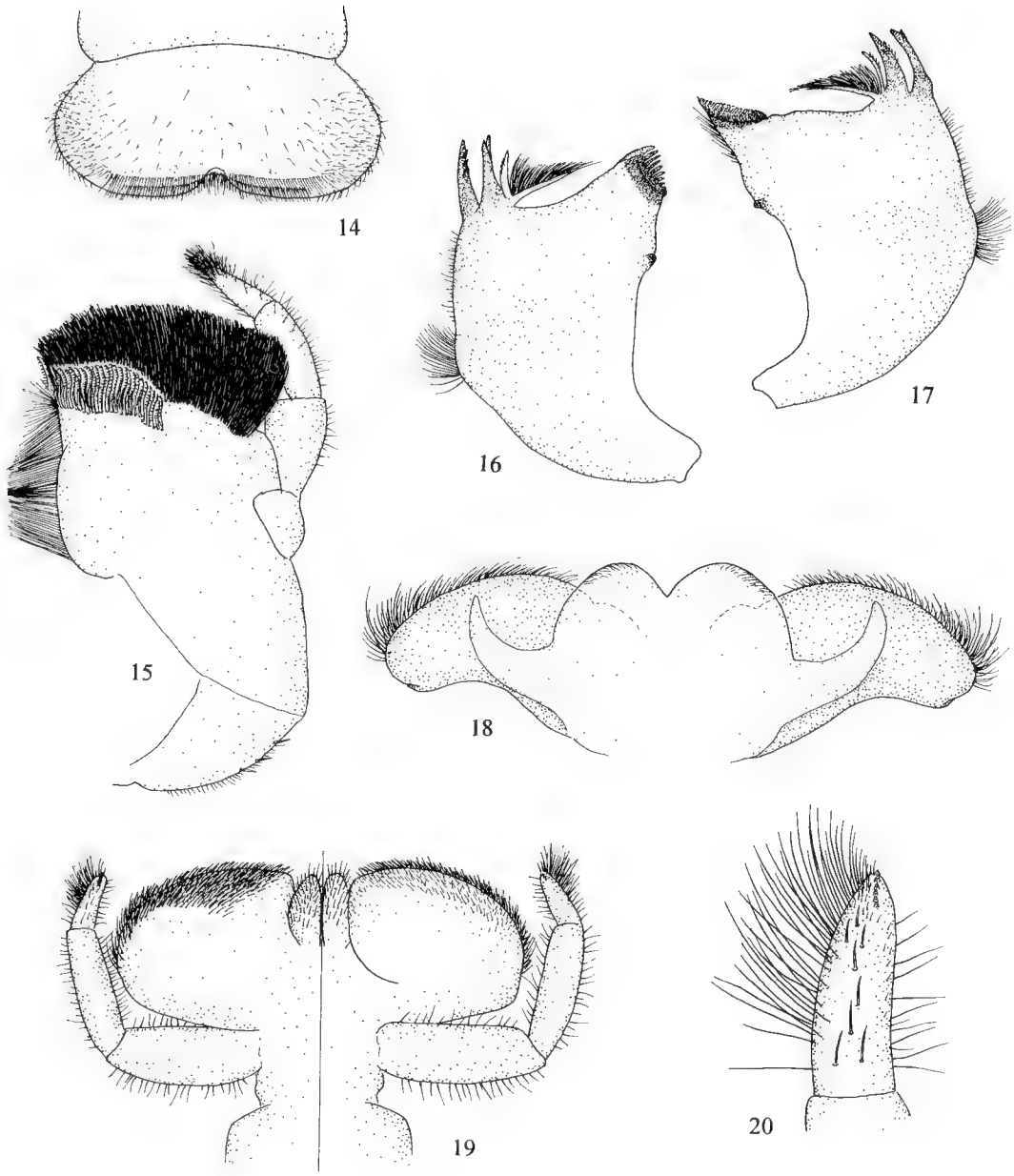
Pescador, M.L. and Peters, W.L., 1980. Phylogenetic relationships and zoogeography of cool-adapted Leptophlebiidae (Ephemeroptera) in southern South America. Pp 43–56 in: Flannagan, J.F. and Marshall, K.E. (eds), *Advances in Ephemeroptera Biology*. Plenum Press: New York



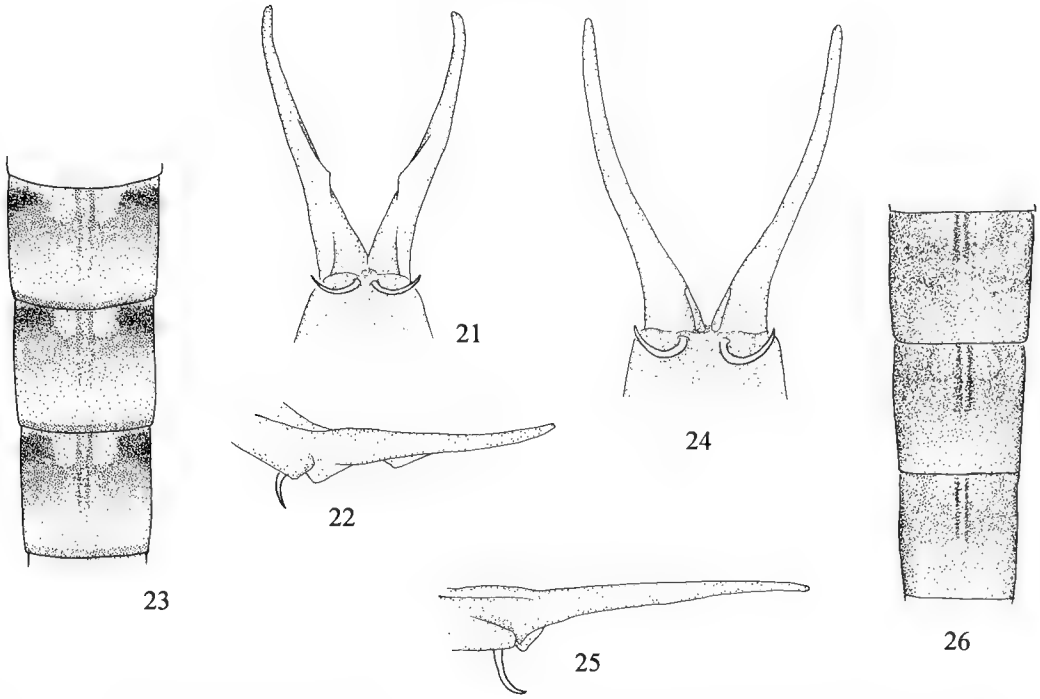
Figures 1–6. *Tillyardophlebia rufosa*. Imago. 1, wings, male; 2, hind wing, male; 3, male genitalia, lateral; 4, male genitalia, ventral; 5, female ninth sternum, ventral; 6, tarsal claws, male.



Figures 7–13. *Tillyardophlebia rufosa*. Nymph. 7, whole nymph, dorsal; 8, postero lateral spines of abdomen; 9, fore-leg; 10, tarsal claw; 11, spines on posterior margin of abdominal tergum 6; 12, gill from abdominal segment 4; 13, terminal filament, midlength.



Figures 14–20. *Tillyardophlebia rufosa*. Nymphal mouth parts. 14, labrum; 15, left maxilla, ventral; 16, left mandible, dorsal; 17, right mandible, dorsal; 18, hypopharynx; 19, labium, dorsal (left of midline) and ventral (right of midline); 20, terminal segment of labial palp, dorsal.



Figures 21–26. Male imagos. *Tillyardophlebia rufosa.* 21, penes, ventral; 22, penes, lateral; 23, abdominal terga 4–6, dorsal; *T. alpina* 24, penes, ventral; 25, penes, lateral; 26, abdominal terga 4–6, dorsal.

Memoirs of the Museum of Victoria 56(1):91–123 (1997)

PHYLOGENY AND BIOGEOGRAPHY OF AUSTRALIAN GENERA OF CHLOROCYSTINI (INSECTA: HOMOPTERA: TIBICINIDAE)

A.J. De Boer

Instituut voor Systematiek en Populatie Biologie (Zoölogisch Museum), University of Amsterdam, PO Box 94766, 1090 GT Amsterdam, The Netherlands

Abstract

Boer, A.J. de, 1997. Phylogeny and biogeography of Australian genera of Chlorocystini (Insecta: Homoptera: Tibicinidae). *Memoirs of Museum of Victoria* 56(1): 91–123.

Six cicada genera belonging to the Chlorocystini are endemic to Australia. These (*Chlorocysta* Westwood, 1851; *Cystopsaltria* Goding and Froggatt, 1904; *Cystosoma* Westwood, 1842; *Glaucopsaltria* Goding and Froggatt, 1904; *Owra* Ashton, 1912; and *Venustria* Goding and Froggatt, 1904) can be divided into three monophyletic groups. The phylogeny and biogeography of these groups is discussed, descriptions are given of the groups and all species concerned. A key to males is presented for all species of Chlorocystini in Australia.

Introduction

The "*Baeturia* and related genera complex" was defined as a supposedly monophyletic group for which aedeagal characters are regarded synapomorphic (De Boer, 1990). Recently this complex was identified as the tribe Chlorocystini (sensu stricto) (De Boer, 1995d) comprising about 150 species attributed to 14 genera. Most species occur in New Guinea but the distribution of the tribe includes Maluku and Timor, the Bismarck Archipelago, Solomon Islands, Vanuatu, Samoa, Tonga and parts of northern and eastern Australia.

Of the 13 species in Australia two (*Thaumastopsaltria globosa* Distant, 1897 and *Guineapsaltria flava* (Goding and Froggatt, 1904)) also occur in New Guinea. All others are endemic to Australia and, apart from *Gymnotympana rufa* (Ashton, 1914) and *Gymnotympana varicolor* (Distant, 1907), belong to endemic Australian genera.

The present publication forms part of a phylogenetic and biogeographic study of the Chlorocystini (sensu stricto) and deals with the endemic Australian genera: *Chlorocysta* Westwood, 1851; *Cystopsaltria* Goding and Froggatt, 1904; *Cystosoma* Westwood, 1842; *Glaucopsaltria* Goding and Froggatt, 1904; *Owra* Ashton, 1912; and *Venustria* Goding and Froggatt, 1904. *Cystosoma* has two species, *Chlorocysta* three and the others are monotypic.

All nine species were recently discussed (Moulds, 1990) but descriptions and drawings of male genitalia are given for the first time here. The redescriptions recount the characters used in a phylogenetic reconstruction of the Chlorocystini as a whole (De Boer, 1995d). Here, the relationships of and between Australian genera are discussed separately. A computer analysis of the distribution of shared characters of all 148 species of the Chlorocystini (sensu stricto) has shown that the Australian genera can be subdivided into three groups:

1. *Cystopsaltria* and *Cystosoma*, as monophyletic group;
2. *Chlorocysta*, *Glaucopsaltria* and *Owra*, as monophyletic group; and
3. *Venustria*.

The latter takes a somewhat isolated position, but is presumably closely related to *Gymnotympana* Stål, 1861 and shares several characters with the Australian species (*G. rufa* and *G. varicolor*) (De Boer, 1995a; 1995d).

The results of phylogenetic analysis (De Boer, 1995d) are summarised and relationships within and between the Australian groups is treated in more detail. The groups are diagnosed and all species are described. A key to males of all Australian species of the Chlorocystini is presented.

Methods

The material examined for this study is preserved in the following collections: BMNH, Natural History Museum (formerly: British Museum (Natural History)), London; BPBM, Bernice P. Bishop Museum, Honolulu; CSIRO, Commonwealth Scientific and Industrial Research Organisation, Canberra; DEI,, Deutsches Entomologisches Institut, Eberswalde; IZW, Polska Akademia Nauk, Instytut Zoologii, Warszawa; KBIN, Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels; Moul, personal collection Mr M.S. Moulds,

Sydney; RMNH, Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden; SEM, Snow Entomological Museum, Lawrence, Kansas; SMD, Staatliches Museum für Tierkunde, Dresden; SMF, Natur Museum und Forschungs Institut "Senkenberg", Frankfurt am Main; SMN, Staatliches Museum für Naturkunde, Stuttgart; ZIM, Zoologisches Institut und Zoologisches Museum, Hamburg; ZMA, Instituut voor Systematiek en Populatie Biologie (Zoölogisch Museum), Amsterdam; ZMB, Institut für Spezielle Zoologie und Zoologisches Museum der Humboldt-Universität, Berlin; and ZMH, Zoological Museum of the University of Helsinki, Helsinki.

Some of the terms used in the descriptions are explained in figs 5 and 13. To examine the male genitalia the pygofer was pulled out after overnight softening, with a sharp needle inserted between the pygofer and the 8th abdominal segment. The aedeagus was pulled out at the same time by inserting the needle between the claspers. Descriptions were made from dried museum material. This drying often affects colour. Bright green becomes yellowish brown, but colour marks like blackish stripes and spots remain intact. Measurements are based on all available specimens. Only some of the most important and the most recent systematic literature concerning the genera and species is cited. For more complete lists of literature is referred to the catalogues of Metcalf (1963) and Duffels and Van der Laan (1985).

Phylogeny

In the following discussion figures in parentheses refer to apomorphies in the cladogram (fig. 1). The Chlorocystini (sensu stricto) form a monophyletic group for which an S- curved aedeagus with winged lateral crests is the supposed apomorphy (1). The phylogenetic relationships between the 148 described species of this tribe were analysed with the aid of the program PAUP (Swofford, 1993) using a data matrix of 154 characters and 409 character states (De Boer, 1995d). The tribe Prasiini was used as the sister group and the genus *Muda* as outgroup. The result of this analysis showed that on a generic level the support of some of the proposed phylogenetic relationships is very weak.

Two major subdivisions can be made. *Chlorocysta*, *Glaucopsaltria*, *Owra* and *Venustria* can be grouped with *Baeturia*, *Guineapsaltria*, *Gymnotympana*, *Papuapsaltria* and *Scottotympana* based on the following synapomorphies: proximal spine of fore femur erect (3), a smoothly vaulted pronotum without distinct medial fissure (4) and a distinct hyaline border along the hind margin of tegmen (5). Other genera have a somewhat wrinkled head and pronotum with a fairly distinct medial fissure on the pronotum and a very narrow border along the hind margin of tegmen; these character states also occur in most species of the Prasiini, the presumed sister group of the tribe.

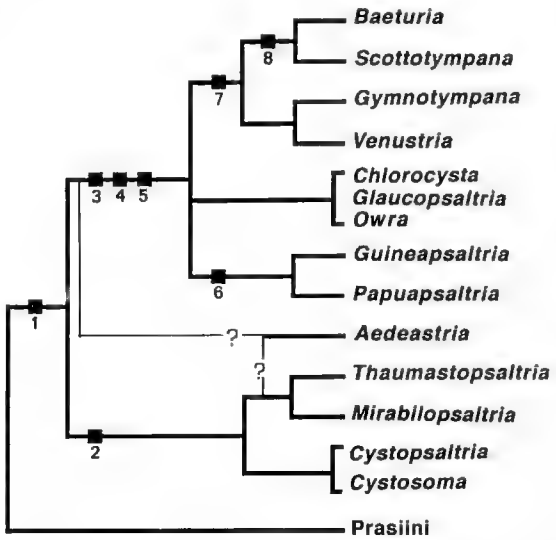


Figure 1. Tentative cladogram of the Chlorocystini. Numbers refer to apomorphies discussed in the text.

Another subdivision can be made based on male operculum size. *Venustria* forms a monophyletic group with *Baeturia*, *Gymnotympana* and *Scottotympana*. These genera share a fairly large operculum as apomorphy (7) in which the medial margin lies medial to the meracanthus. In other genera of Chlorocystini, in Prasiini and in *Muda* the medial margin of the operculum lies generally lateral to the meracanthus.

Several characters of *Venustria* are also found in *Scottotympana* and many species of *Gymnotympana* and indicate a close relationship with these two genera:

1. tegmina with reddish venation and a broad hyaline border along the hind margin;
2. a long proximal spine on the fore femur, often longer than the distance to middle spine; and
3. a very short meracanthus.

However, *Baeturia* and *Scottotympana* presumably form a monophyletic group; claspers which are not fused at the base are a presumed synapomorphy for these two genera (8). *V. superba* shares a very similarly shaped basal part of the operculum with *Gymnotympana rufa* and

G. varicolor while the female of *V. superba* shares a similar thorn-shaped protuberance on the pygofer with *G. rufa*. (De Boer, 1995a; 1995d). The last two characters suggest that *Venustria* should be included in and be synonymised with *Gymnotympana* but no unambiguous synapomorphy for *Venustria* and *Gymnotympana* together has been found. The phylogenetic analysis showed that *Venustria* as the sister group of *Gymnotympana* is the most parsimonious solution (De Boer, 1995d).

The phylogenetic relationships between *Chlorocysta*, *Glaucopsaltria* and *Owra* and the group formed by *Baeturia*, *Guineapsaltria*, *Gymnotympana*, *Papuapsaltria*, *Scottotympana* and *Venustria* are not clear, as indicated by the polytomy in fig. 1. *Guineapsaltria* and *Papuapsaltria* are possibly sister groups, based on a very small and rounded male operculum in many of their species (6). *Chlorocysta*, *Glaucopsaltria* and *Owra* share a very broad vertex with the small ocelli wide apart with most species of *Gymnotympana* and all but one species of *Guineapsaltria*; the distance between the lateral ocelli often exceeds three times the width of the frontal ocellus. The fairly short meracanthus of the species of *Chlorocysta*, *Glaucopsaltria* and *Owra* and the vague colour pattern found on the head and thorax of two of the *Chlorocysta* species, might indicate a close relationship with *Gymnotympana*, *Scottotympana* and *Venustria*. The phylogenetic analysis showed that a reconstruction with *Chlorocysta*, *Glaucopsaltria* and *Owra* as sister group of *Baeturia*, *Gymnotympana*, *Scottotympana* and *Venustria* is slightly more parsimonious than the option with *Guineapsaltria* and *Papuapsaltria* as sister group of that group. On a tree with a total length of 906 steps the latter option is only one step longer (De Boer, 1995d).

Cystosoma and *Cystopsaltria* share a strongly furrowed pronotum and a very narrow border along the hind margin of tegmen with *Aedeastria*, *Mirabilopsaltria* and *Thaumastopsaltria*, a strongly bent proximal spine on the fore femur with *Mirabilopsaltria* and *Thaumastopsaltria* and an angularly protruding postclypeus with *Thaumastopsaltria*. All these characters are also widely distributed in Prasiini and are presumed plesiomorphic. Furthermore, *Cystosoma* and *Cystopsaltria* have small male opercula which are regarded plesiomorphic; the opercula of *Cystosoma schultzi* and *Cystopsaltria immaculata*, though relatively small, do slightly extend medially of the meracanthus but the operculum of *Cystosoma saundersii* does not. The two species of *Cystosoma* and most species of *Thaumastopsaltria* and *Mirabilopsaltria* have a narrow tymbal cavity; the tergite part between the auditory capsule and the 2nd sternite is very short. This character is presumably apomorphic for *Cystosoma*, *Cystopsaltria*, *Mirabilopsaltria* and *Thaumastopsaltria* together but then lost in some of the species (2). It is not clear whether or not *Aedeastria* should also be included in this group; though *Aedeastria* has a wide tymbal cavity it shares distinct diverging fissures on the vertex as a possible synapomorphy with *Mirabilopsaltria* and *Thaumastopsaltria*. The erect fore femoral spine of *Aedeastria*, however, suggests a monophyletic origin with the group containing *Baeturia*, *Chlorocysta*, *Glaucopsaltria*, *Gymnotympana*, *Guineapsaltria*, *Owra*, *Papuapsaltria*, *Scottotympana* and *Venustria* (see fig. 1 questionmarks)

The coloured tegmina of *Cystosoma* and *Cystopsaltria* which are also found in *Mirabilopsaltria* and *Thaumastopsaltria* might also indicate a relationship between these genera though this character is also found in some genera of Prasiini.

Biogeography

Biogeographic patterns of Chlorocystini and a similarly distributed group of cicadas, the subtribe Cosmopsaltriaria, were recently compared and analysed (De Boer, 1995c). It appears that most of the species of these groups are found on terranes derived from a historic oceanic island arc, which developed since about 40 million years ago as a result of subduction of the former Tethys Sea under the Pacific tectonic plate (De Boer, 1995c). This arc is known as the Outer Melanesian Arc (Hamilton 1979; Holloway, 1979, 1984; Duffels, 1986; Rangin et al., 1990a, 1990b; Daly et al., 1991). Due to the continuous northward movement of Australia and the westward movement of the Pacific this volcanic island arc broke up and fragments collided with the northern craton of Australia where they now form part of New Guinea (Pigram and Davies, 1987). It is supposed that the Outer Melanesian Arc, before breaking up, formed an important route of dispersal for south-east Asian biota invading the Pacific (Duffels 1986, Duffels and De Boer, 1990, De Boer, 1995c).

The distribution of Chlorocystini over the arc terranes, the fact that their presumed sister group (the oriental Prasiini as defined by De Jong, 1985) is most speciose in Sulawesi and that the sister group of these groups combined (the genus *Muda*) occurs in south-east Asia and the

greater Sunda Islands, suggest that the ancestor of that tribe also used the island arc as route of dispersal. In fact, the distribution and phylogeny of these cicadas reflect the geotectonic history in that the main vicariant speciation events in the cladograms correspond with presumed sequences of fragmentation of the island arc (De Boer, 1995c). This means that the ancestor of Chlorocystini originates from Asia and that all its Australian species must have invaded Australia by dispersal presumably through New Guinea (De Boer, 1995c).

Two patterns of distribution of Australian Chlorocystini can be recognized. It appears that species not belonging to endemic genera but belonging to genera found in New Guinea as well (*Guineapsaltria flava*, *Gymnotympana rufa*, *Gymnotympana varicolor* and *Thaumastopsaltria globosa*) are restricted to the northern and eastern parts of the Cape York Peninsula; the only exception (*T. globosa*) is also recorded from Groote Eylandt, NT (Moulds, 1990). This same pattern is found in several species that do not belong to Chlorocystini: *Diceropyga subapicalis* (Walker, 1868) (see Duffels, 1977), *Lembeja paradoxa* (Karsch, 1890) and *Lembeja vitticollis* (Ashton, 1912) (see De Jong, 1982) belong to non-endemic genera and are restricted to the Cape York Peninsula (Moulds, 1990).

Venustria, an endemic Australian genus that should possibly be included in *Gymnotympana* (see discussion above; De Boer, 1995a; 1995d), is also restricted to the Cape York Peninsula. The two groups of endemic Australian genera have a much wider distribution, reaching farther southward. These have a strikingly similar distribution in northern and eastern Qld, including the Cape York Peninsula and north-eastern NSW.

The distribution patterns of the species of endemic and non-endemic Australian genera and their relative positions in the cladogram suggest different ages. There must have been at least two periods of dispersal from New Guinea to Australia. For the non- Australian genera a dispersal during Pliocene-Pleistocene low sea-level stands has been proposed (De Boer, 1992b; 1995c). The two groups of endemic Australian genera branch off lower down in the cladogram and must therefore be older. Their ancestors must have reached Australia earlier, possibly following the first collision between Australia and a fragment of the Outer Melanesian Arc, which is dated at about 25 mya (Pigram and Davies, 1987; De Boer, 1995c).

For maps of distribution of the Australian species described here see Moulds (1990) and De Boer (1995c).

Key to males

1	Tegmen with variable venation, often differing between left and right tegmen of individuals, forming 9 or more apical areas and several subapical areas between apical and ulnar areas 2
—	Tegmen venation regular, with 8 or 9 apical areas, but without subapical areas 10
2(1)	Tegmen hyaline, with fairly broad hyaline border along hind margin and broad costal area. Proximal spine of fore femur erect (fig. 20). Postclypeus not swollen ventrally (figs 4, 45). Pronotum smooth, without distinct medial furrow 3
—	Tegmen opaque or weakly reddish or greenish tinged, with narrow border along hind margin and narrow costal area. Proximal spine of fore femur strongly bent, adjacent to femur (fig. 60). Postclypeus distinctly swollen ventrally (fig. 70). Pronotum with distinct medial furrow 7
3(2)	Aedeagus Z-curved in apical part, proximal part straight (cf. fig. 12). Tymbal with 9 or more ridges 4
—	Aedeagus S-curved (figs 31, 42). Tymbal with 6–8 ridges ... 6
4(3)	Head and thorax without colour markings. Tymbal with 9–10 ridges. Clasper base forming a low collar around base of anal valves, which is sloping proximally of aedeagus (fig. 6). Aedeagus not incised at apex (figs 11, 12) ..... *Chlorocysta vitripennis*

— Head and thorax with pattern of dark brown spots and stripes. Tymbal with 11–12 ridges. Clasper base forming a high collar around base of anal valves, which is erect proximally of aedeagus (figs 14, 25). Aedeagus incised at apex (figs 18, 27) 5

5(4) Distomedial corner of operculum not reaching medially of meracanthus (fig. 24). Ventral part of postclypeus darkly suffused. Tymbal with 12 ridges, 4 of which do not reach ventral tymbal margin ..... *Chlorocysta suffusa*

— Distomedial part of operculum almost pointed, elongate, reaching medially of meracanthus (fig. 15). Ventral part of postclypeus not darkly suffused. Tymbal with 11 ridges, 4 of which do not reach ventral tymbal margin ..... *Chlorocysta fumea*

6(3) Body length over 28 mm. Abdomen strongly inflated. Seventh tergite wedge- shaped in lateral view, long dorsally and short at ventral margin; pygofer turned to a ventral position. Distal part of operculum longer than basal part and reaching beyond apex of meracanthus (fig. 44). Wing with 6 apical areas .... *Glaucopsaltria viridis*

— Body length under 18 mm. Abdomen weakly inflated. Seventh tergite not wedge- shaped in lateral view; pygofer directed posteriad. Distal part of operculum much shorter than basal part and not reaching to apex of meracanthus (fig. 33). Wing with 5 apical areas ..... *Owra insignis*

7(2) Tegmina rounded at apex, venation not reticulate. Wings with 6 apical areas. Pronotum not forming a sharply edged lateral crest. Head and pronotum not triangle-shaped; anterior margins of postclypeus and vertex lobes not forming a continuous line with lateral margins of pronotum. Cruciform elevation of mesonotum broader than long across its centre. First and second sternites not adjacent. Clasper straight, with broad domed clasper hollow and with laminiform and sharply pointed medial protrusion. Tymbal with 6 ridges ..... *Thaumastopsaltria globosa*

— Tegmina pointed at apex, venation reticulate in distal half. Wings with more than 6 apical areas. Pronotum forming a sharply edged lateral crest. Head and pronotum triangle-shaped; anterior margins of postclypeus and vertex lobes forming an almost continuous line with lateral crest of pronotum. Cruciform elevation of mesonotum narrower than long across its centre. First and second sternites adjacent. Clasper hook-shaped, with narrow clasper hollow in downwardly directed apical part and without medial protrusion. Tymbal with 7 or more ridges 8

8(7) Veins CuA and M not fused at corner of basal area (fig. 72). First radial area of tegmen divided by longitudinal vein. Venation of apical and ulnar areas reticulate. Pygofer opening narrow, V-shaped (fig. 78). Aedeagus with dorsal appendages near its apex (figs 85, 86). Tymbal with 10 ridges .*Cystopsaltria immaculata*

— Veins CuA and M fused at corner of basal area (fig. 81). First radial area of tegmen not divided. Venation of apical areas reticulate, ulnar areas normal. Pygofer opening broad, U-shaped (fig 57). Aedeagus without dorsal appendages (figs 62, 77). Tymbal with 7 ridges 9

9(8) Body length over 40 mm. Abdomen globularly inflated. Medial margin of operculum not reaching medially of meracanthus (fig. 68). ..... *Cystosoma saundersii*

— Body length under 30 mm. Abdomen distinctly but not globularly inflated. Medial margin of operculum reaching medially of meracanthus (fig. 71) ..... *Cystosoma schmeltzi*

10(1) Wing with extremely slender anal fields; 2nd anal field rudimentary, not hyaline. Abdomen with reddish ventral band. Tergites sharply folded towards sternites ventrolaterally. Ventral part of pygofer not incurved to its margins; ventral and basal margins of pygofer forming a continuous, sharply edged, ridge 11

— Wing with broad anal fields; 2nd anal field distinct and hyaline. Abdomen without reddish ventral band. Tergites gradually curved towards sternites ventrolaterally. Ventral part of pygofer gradually incurved to its margins; ventral and basal margins of pygofer not forming a sharply edged ridge 12

11(10) Tymbal with 5 ridges. Tymbal and lateral part of 2nd tergite separated by broad wedge-shaped cavity. Second tergite strongly curved between auditory capsule and 2nd sternite. Caudodorsal beak erect and conically shaped; its lateral margins curving inwards and fusing. Aedeagus short and almost straight, directed upwards, not reaching beyond ventral margin of pygofer ..... *Gymnotympana rufa*

— Tymbal with 4 ridges. Tymbal and lateral part of 2nd tergite separated by narrow gap. Second tergite straight between auditory capsule and 2nd sternite. Caudodorsal beak strongly curved, but not conically shaped, its lateral margins not fusing. Aedeagus long and strongly curved down, reaching beyond ventral margin of pygofer ..... *Gymnotympana varicolor*

12(10) Body length over 20 mm. Operculum large, covering most of tymbal cavity and reaching medially of meracanthus. Basal part of operculum medially distinctly longer than laterally (fig. 55). Tegmina slightly bronzed, with 9 apical areas. Clasper broad and lobate, with large clasper hollow and strongly curved down, not forming a shaft around aedeagus (fig. 51). Aedeagus erect, its apex adjacent to base of anal valves. Aedeagus broad, swollen in proximal part and without subapical lobe ..... *Venustria superba*

— Body length under 16 mm. Operculum small, not covering tymbal cavity and not reaching medially of meracanthus. Basal part of operculum oblong. Tegmina clear hyaline, with 8 apical areas. Clasper long, slender and straight, without distinct clasper hollow, directed posteriad and forming a shaft around aedeagus. Aedeagus directed posteriad between claspers, its apex near apex of clasper. Aedeagus very slender, with distinct subapical lobe. ..... *Guineapsaltria flava*

Chlorocysta, Glaucopsaltria and *Owra*

Description. The species of *Chlorocysta* and *Glaucopsaltria* are large compared to other Chlorocystini, body length 20–33 mm; only *Owra* is distinctly smaller, under 16 mm. Body reddish brown or greenish, generally uniformly coloured, but abdomen often with reddish segmental hind margins and a row of dark coloured ventrolateral spots. Male abdomen strongly inflated 1.4–2.3 × as long as head and thorax together, in females 0.9–1.2 ×. Head broad and short (fig. 3), 2.4–3.0 × as wide as long and 1.8–2.2 × as wide as distance between eyes. Postclypeus broad and bluntly rounded anteriorly, 2.3–3.3 × as wide as long. Anterior margin of postclypeus continuous with anterior margins of vertex lobes. Sides of postclypeus with about 8–10 distinct furrows, ending in short rows of short parallel ridges, which form a narrow band along

lorum. Postclypeus not swollen ventrally; anterior margin (lateral view) straight or weakly convex (fig. 4). Vertex very broad and smooth; diverging fissures from centre of head to corners of postclypeus weakly developed. Vertex lobes sometimes with some weak longitudinal wrinkles. Vertex 1.7–2.4 × as wide as long; 1.3–1.6 × as wide as postclypeus and 1.6–2.4 × as wide as eye. Ocelli small and far apart. Distance between lateral ocelli 2.4–4.1 × width of frontal ocellus and 0.8–1.2 × distance between lateral ocellus and eye. Pronotum 2.3–2.6 × as wide as long and fairly smooth, without medial furrow. Pronotal collar laterally weakly amplified and slightly curving down at anterior margin of lateral amplifications. Tegmina and wings hyaline, venation reddish or sometimes ochraceous. Tegmen venation variable with 9–15 apical areas and a more or less continuous band of subapical areas. Costal area hyaline and very distinct, widening towards tegmen apex. A distinct hyaline border along hind margin of tegmen (fairly narrow in *Owra*). Wings with 5, in *Glaucopsaltria* 6, apical areas and a distinctly broader hyaline border than in tegmina. Legs ochraceous and unmarked. Fore femur (fig. 20) with row of 3 erect and sharply pointed spines, diminishing in length towards tibia. Tymbal with 6–12 parallel sclerotized ridges. The most proximal ridges often not reaching ventral margin of tymbal. Short intercalary ridges forming a lateral band at half- width across tymbal. Opercula very small. Basal part of operculum slightly vaulted with two rounded elevations and weakly wedge-shaped; longest medially and gradually tapering towards lateral margin. Basal part with distinct crest around its distolateral corner, lateral part of this crest very short and in males often globularly swollen. Distal part of operculum in males angularly oblong and longer than basal part (though extremely short in *Owra*) and not, or only partly covering tymbal cavity in ventral view; often leaving most of folded membrane exposed. Lateral margin of male operculum straight or weakly convex, slightly directed mesiad and forming a distinct and obtuse angle with crest of basal part and with straight distal margin. The straight medial margin lies laterally of meracanthus. Meracanthus fairly short, but generally reaching beyond operculum. Female operculum shorter than in male and sickle-shaped. Male abdomen very delicate and distinctly inflated. First tergite in male medially often more than half as long as 2nd tergite (but *Glaucopsaltria* with extremely long 2nd tergite) and not hidden under metanotum. Middorsal part of second tergite hardly longer than lateral parts, proximal margin of second tergite weakly convex medially. Lateral parts of 2nd tergite weakly swollen at anterior margins and adjacent to tymbals. Tergite part between auditory capsules and sternite 2 almost straight, forming a distinct ridge along tymbal cavity. Sternites 1 and 2 not adjacent (fig. 13 arrow). Auditory capsules not swollen, hardly elevated relative to connecting bar between abdomen and tymbal. Female abdomen shorter and more robust than that of male, with short and broad pygofer (fig. 22). Ovipositor sheaths almost reaching to apex of sharply pointed caudodorsal beak. Male pygofer short and rounded, with convex distal and ventral margins. Caudodorsal beak short and erect; not curving over basal part of claspers or anal valves and bluntly rounded, truncate, or rectangular at apex. Lateral lobes of pygofer weakly curved inwards with small, weakly inflated, protuberances. Ventral margins of pygofer converging, generally forming a sharp angle at base of pygofer opening. Claspers fairly slender and hook-shaped; sharply curving down at half-length. Apical part of clasper with large, sharply edged, clasper hollow (in *Owra* without clasper hollow). Claspers weakly diverging towards rounded apices. Basal part of clasper forming a continuous ring-shaped collar around base of anal valves. Aedeagus S-curved (in *Chlorocysta* more Z-curved in apical part), with very narrow lateral crests along proximal part.

Monophyly of the three genera. In the following discussion figures in parentheses refer to apomorphies in the cladogram (fig. 2). *Chlorocysta*, *Glaucopsaltria* and *Owra* form a monophyletic group based on the following synapomorphies: 1, a continuous band of subapical areas in tegmen; 2, a wedge shaped basal part of operculum; and 3, small male auditory capsules (De Boer, 1995d).

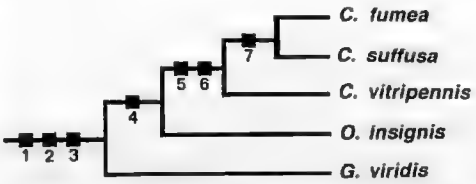


Figure 2. Cladogram of the species of *Chlorocysta*, *Glaucopsaltria* and *Owra*. Numbers refer to apomorphies discussed in the text.

The tegmen venation tends to be variable and often differs between left and right tegmen within individuals. The number of apical areas

varies from 9–10 in *Owra* to 11–13 in *Chlorocysta* and to 13–15 in *Glaucopsaltria* but is always more than 8, the number most common in related genera and in most cicadas. Furthermore, the tegmina have a more or less continuous band sometimes of a double row of subapical areas between apical and ulnar areas. Similarly high numbers of apical areas in the tegmina are also found in *Baeturia inconstans* De Boer (De Boer, 1994c), *Gymnotympana* (4 species, De Boer, 1995a), *Mirabilopsaltria* (2 species, De Boer, 1996) and all but one species of *Thaumastopsaltria* (De Boer, 1992b). A continuous band of subapical areas is regarded apomorphic for *Chlorocysta*, *Glaucopsaltria* and *Owra* (1 in fig. 2). Although in the tegmina of the species of *Gymnotympana*, *Mirabilopsaltria* and *Thaumastopsaltria* noted above some subapical areas occur, these never form a continuous band. Subapical areas do not occur in *Baeturia*.

The basal part of the male operculum is slightly wedge-shaped, longest medially and slightly tapering to its lateral margin. The operculum base is generally oblong in species of Chlorocystini but in most species of *Gymnotympana* the operculum base has its greatest length laterally (De Boer, 1995a). Only in *Gymnotympana rufa*, *G. varicolor* and *Venustria superba* the basal part of operculum is longest medially but narrows more abruptly at about one third of its width. The weakly wedge-shaped operculum base is regarded apomorphic for *Chlorocysta*, *Glaucopsaltria* and *Owra* (2).

Chlorocysta, *Glaucopsaltria* and *Owra* have small and weakly protruding auditory capsules. Although similarly unswollen capsules are present in *Thaumastopsaltria* (De Boer, 1992b) they presumably represent a parallel development and can be regarded as apomorphic for this group (3).

Phylogenetic relationships. Chlorocysta and *Owra* share wings with 5 apical areas synapomorphic for these genera (4). Wings with 5 apical areas occur in several genera of cicadas but only sporadically in other genera of the Chlorocystini.

The three species of *Chlorocysta* share a somewhat Z-curved aedeagus (a modification of the S-curved aedeagus, an apomorphy of the Chlorocystini) and a high number (9–12) of tymbal ridges (5, 6) as apomorphies. *Owra insignis* shares an incised aedeagal apex with *C. fumea* and *C. suffusa* but similarly incised aedeagal apices occur in several related genera (e.g., *Aedeastria*, *Guineapsaltria* and *Papuapsaltria*). *C. fumea* and *C. suffusa* are supposed to be sister species sharing a large tymbal with 11–12 ridges (7). Furthermore, these species share a wide pygofer opening and a distinct colour pattern on head and thorax but the phylogenetic value of these characters is not clear since they also occur in several related genera.

Chlorocysta Westwood

Cystosoma (Chlorocysta) Westwood, 1851: 208. — Walker, 1852: 1133.

Chlorocysta.-Stål, 1863: 575. — Goding and Froggatt, 1904: 566, 596, 658. — Distant, 1906: 153, 159. — Boulard, 1979: 35. — Duffels and Van der Laan, 1985: 249. — Moulds, 1990: 185–186. — De Boer, 1990: 64. — De Boer, 1991: 2–3. — De Boer, 1992a: 164. — De Boer, 1993a: 16–17. — De Boer, 1993b: 142. — De Boer, 1994a: 3. — De Boer, 1995a: 4, 8, 24. — De Boer, 1995b: 6.

Glaucocysta Goding and Froggatt, 1904: 566.

Mardalana Distant, 1905: 213, 215. — Distant, 1906: 154, 159. — Metcalf, 1963: 257. — Duffels and Van der Laan, 1985: 249.

Mardarana [sic] Kato, 1932: 185. — Kato, 1956: 70.

Mardalena [sic] Boulard, 1979: 46.

Type species. Cystosoma vitripennis Westwood, 1851.

Diagnosis. Green body. Basal part of operculum wedge shaped. Male abdomen strongly inflated. Male auditory capsules weakly inflated. Tegmina with more than eight apical areas and continuous band of subapical areas. Tymbal with 9–12 ridges. Aedeagus in lateral view Z-shaped near apex.

Remarks. Chlorocysta, originally described as a subgenus of *Cystosoma*, is the type genus of Chlorocystini Distant, 1905. The genus contains three species but several undescribed species have been distinguished (Moulds, pers. comm.). The peculiarly Z-curved aedeagus is a supposed apomorphy for *Chlorocysta*.

Chlorocysta vitripennis (Westwood)

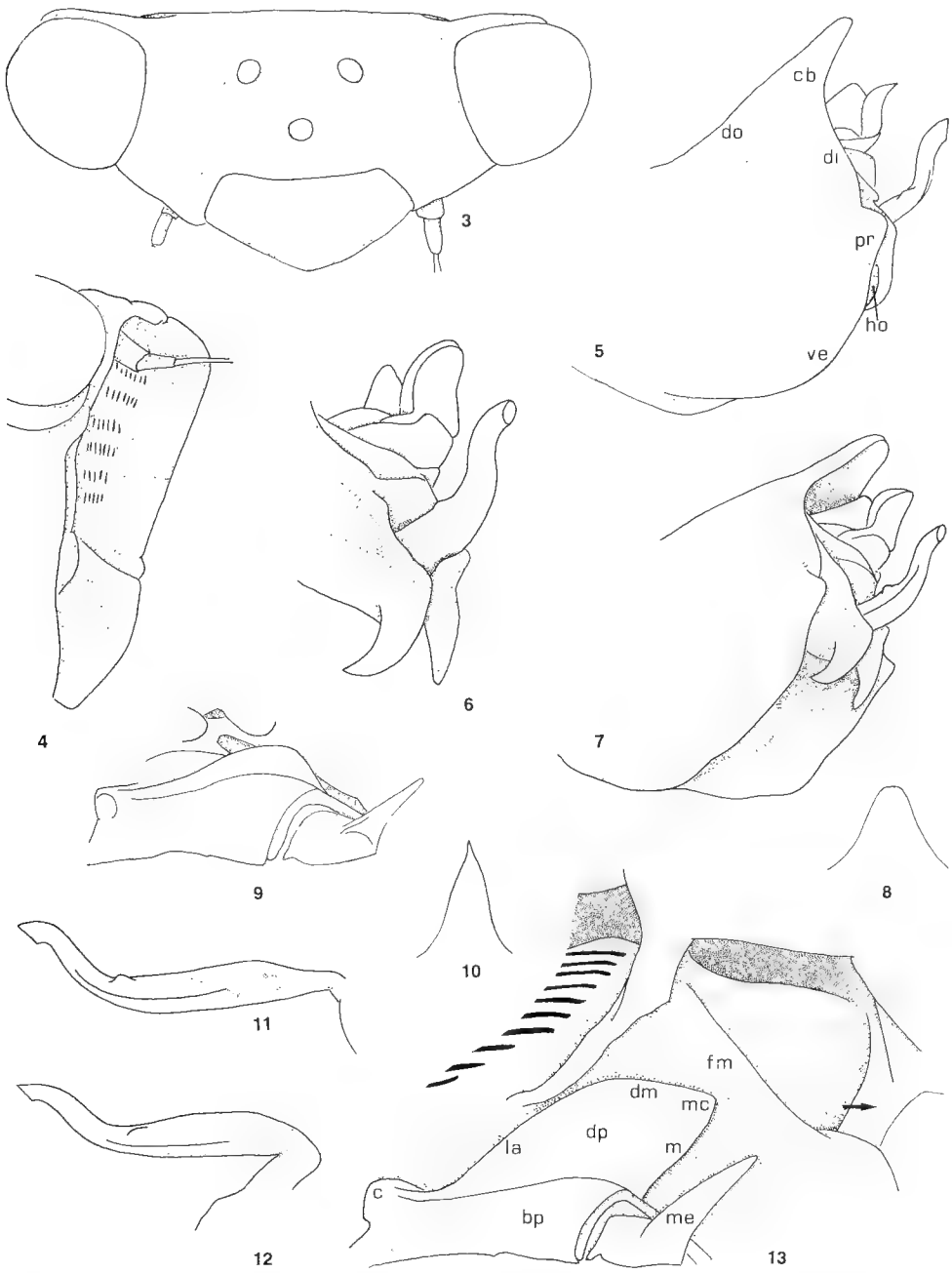
Figures 3–13

Cystosoma (Chlorocysta) vitripennis Westwood, 1851: 208.

Chlorocysta vitripennis. — Goding and Froggatt, 1904: 566, 659, pl. xix fig. 6. — Distant, 1906: 159. — Burns, 1957: 643. — Metcalf, 1963: 256–257. — Duffels and Van der Laan, 1985: 249. — Moulds, 1990: 188–189, pl. 22 figs 2, 2a-b. — De Boer, 1995a: 16, 77. — De Boer, 1995b: 5.

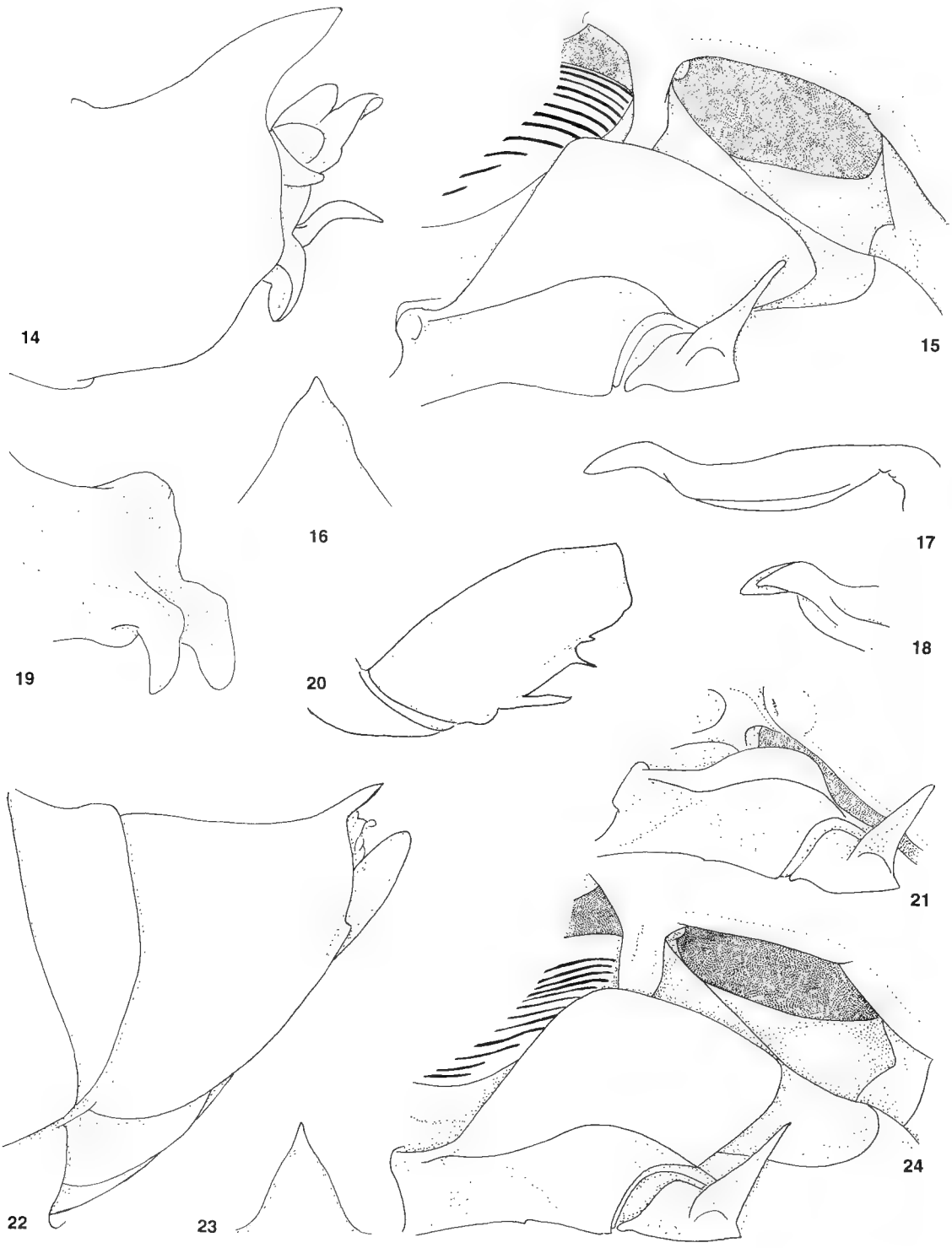
Cicada congrua Walker, 1862: 303–304. — Goding and Froggatt, 1904: 611, 657.

Chlorocysta macrula Stål, 1863: 575. — Goding and Froggatt, 1904: 566, 659, 660.



Figures 3–13. *Chlorocysta vitripennis* Westwood, 1851: 3, male head in dorsal view, Mt Tamborine; 4, male postclypeus in lateral view, Mt Tamborine; 5, pygofer in lateral view, Mt Tamborine; 6, claspers and aedeagus, Mt Tamborine; 7, pygofer in oblique view, Mt Tamborine; 8, male caudodorsal beak in dorsal view, Mt Tamborine; 9, female operculum, Dorrigo; 10, female caudodorsal beak in dorsal view, Dorrigo; 11, aedeagus in lateral view, Mt Tamborine; 12, aedeagus in lateral view, ex. coll. v Voixem; 13, male operculum, Mt Tamborine, arrow indicating gap between sternites 1 and 2.

bp = basal part of operculum; c = crest around distolateral corner of basal part of operculum; cb = caudodorsal beak; dm = distal margin of operculum; di = distal margin of pygofer; do = dorsal margin of pygofer; dp = distal part of operculum; ho = clasper hollow; la = lateral margin of operculum; m = medial margin of operculum; me = meracanthus; mc = medial corner of operculum; pr = protuberance on lateral lobe of pygofer; ve = ventral margin of pygofer.



Figures 14–24. 14–19, *Chlorocysta fumea* Ashton, 1914: 14, pygofer in lateral view; 15, operculum; 16, caudodorsal beak in dorsal view; 17, aedeagus in lateral view; 18, aedeagal apex; 19, claspers. 20–24 *Chlorocysta suffusa* Distant, 1907: 20, male fore femur in lateral view, Cairns; 21, female operculum, Cooktown; 22, female genital segment in lateral view, Cooktown; 23, female caudodorsal beak in dorsal view, Cooktown; 24, male operculum, Julatten.

an almost right angle with slightly longer distal margin. Distal margin straight, but weakly convex near angular distomedial corner. Medial margin straight. Distal part of operculum elongate at distomedial corner, reaching mesiad beyond apex of meracanthus. Meracanthus short, not reaching distal margin of operculum.

Abdomen. Strongly inflated, almost uniformly brown coloured, but with darkened segmental hind margins and a lateral row of darkened spots.

Genitalia. Pygofer in lateral view (fig. 14) short and globularly swollen. Dorsal margin weakly concave, convexly bending into erect caudodorsal beak. Distal margin slightly convex between beak and lateral protuberance. Ventral margin angularly convex. Ventral margins converge to a bluntly rounded angle at base of pygofer opening. Caudodorsal beak in dorsal view (fig. 16) with subapical swelling and pointed apex. Lateral lobe of pygofer with small weakly swollen lateral protuberance. Claspers (fig. 19) fused at base to a continuous and broad collar around base of anal valves. Dorsal margin of clasper ending in right angle on surface of this collar and not forming a lateral crest on lateral surface of clasper base. Collar erect, not domed, between claspers. Distal corner of clasper bending mesiad around aedeagus, supporting aedeagus in upright position. Claspers sharply curving down and strongly diverging towards apices. Apical part of clasper with sharply edged hollow at its inwardly directed side. Aedeagus (fig. 17) slender and apically rounded in lateral view, strongly Z-curved in apical third, basal two-thirds almost straight. Aedeagus with very slender lateral crests and without dorsal swellings. Aedeagal apex with dorsoventral incision; aedeagus ending in two small and almost pointed lateral lobes (fig. 18).

Measurements: Body length: 29.8 mm; tegmen length: 31.7 mm; head length: 2.3 mm; pronotum length: 2.8 mm; mesonotum length: 6.2 mm; head width: 6.5 mm; width of pronotal collar: 7.2 mm.

Distribution. Endemic to the Cape York Peninsula, Qld. Moulds (1990) recorded the species only known from along the old Leo Creek track at the southern end of the McIlwraith Range, at an altitude of around 300 m.

Remarks. C. fumea is the largest species of this genus and is easily recognized by its distomedially elongated male operculum. *C. fumea* is closely related to *C. suffusa*, described next, sharing a similar colour pattern and incised aedeagal apex. Only one male was available for study.

Chlorocysta suffusa (Distant)

Figures 20–29

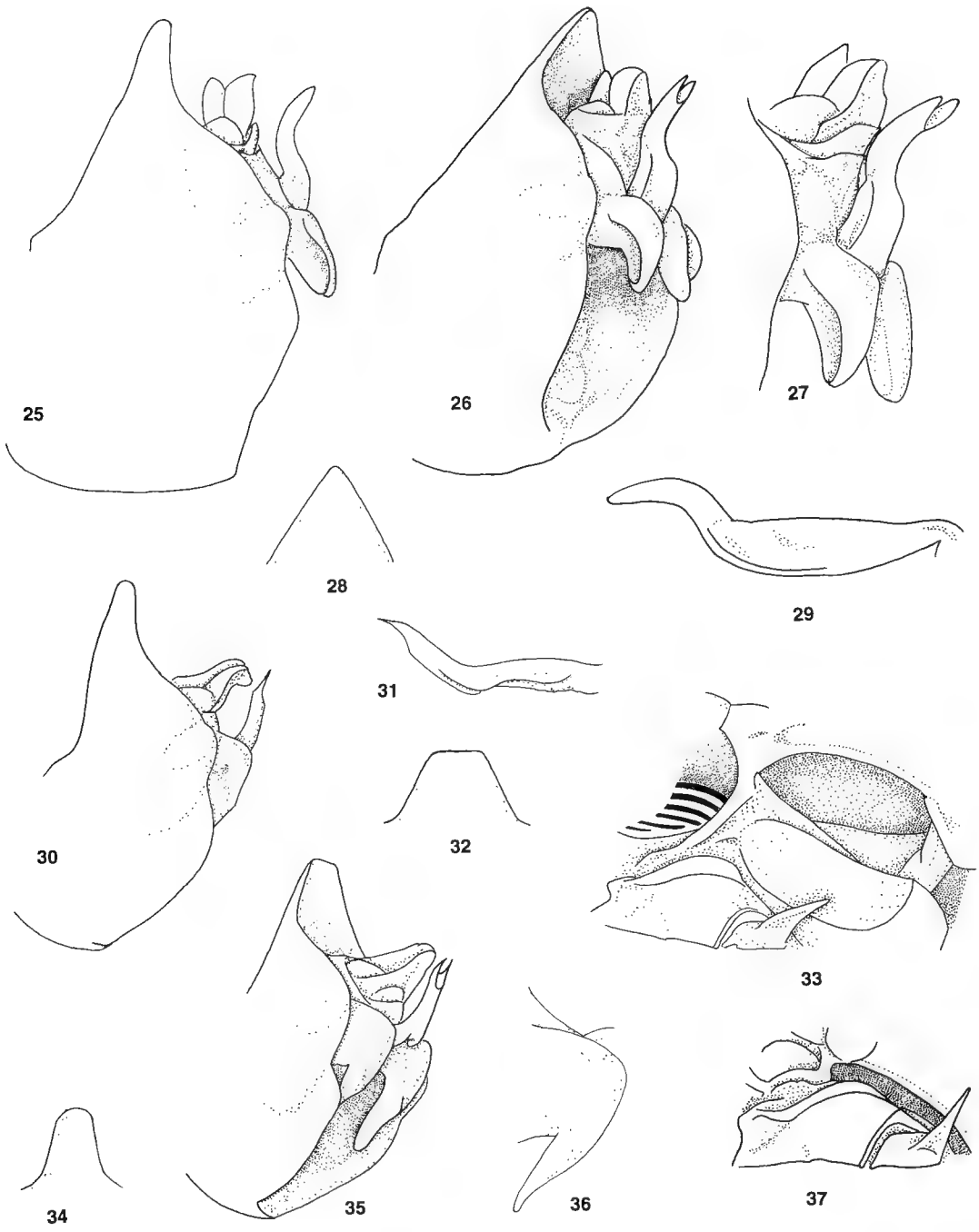
Mardalana suffusa Distant, 1907: 418. — Burns, 1957: 644. — Metcalf, 1963: 258. — Duffels and Van der Laan, 1985: 249.

Chlorocysta suffusa. — Moulds, 1990: 186–187, pl. 22 figs 7, 7a.

Material examined. Australia. S. Qld, Nauklér, coll. Dodd, ♂, ZMH. Cairns 9 km W, ii-iv.1985, ♂, ZMA. Cairns, A.P. Dodd ♂ Det. *Chlorocysta vitripennis* G+F, BPBM. Cairns, 1920, J.F. Illingworth, ♂, ♀ Det. *Chlorocysta vitripennis* G+F, BPBM. Clohesi River, S.F. SW of Kuranda, 18.i.1984, M.S. and B.J. Moulds, ♂ *C. suffusa* det. M.S. Moulds, ♀ *C. suffusa* det. M.S. Moulds. Moul. Gordonvale, J.F. Illingworth, ♂, ♀, BPBM. Julatten, 10.xi.1979, M.S. and B.J. Moulds, ♀ *C. suffusa* det. M.S. Moulds, Moul. Same data but 20.xi.1979, ♂ *C. suffusa* det. M.S. Moulds, Moul. 15.i.1981, ♂ *Mardalana suffusa* det. M.S. Moulds, ZMA. 17.i.1981, ♂ *C. suffusa* det. M.S. Moulds, Moul. 24.i.1981, ♀ *C. suffusa* det. M.S. Moulds, Moul. 13.iii.1982, ♂ *C. suffusa* det. M.S. Moulds, Moul. Kamerunga, nr Cairns, 14.i.1977, M.S. and B.J. Moulds, ♂ *C. suffusa* det. M.S. Moulds, Moul. Kuranda, 200m, 12.iii.1956, J.L. Gressitt, ♂, BPBM. Kuranda, 14.ii.1988, J. Hasenpusch, ♂ *C. suffusa* det. M.S. Moulds, Moul. Quarantine Bay, nr Cooktown, 17.ii.1982, M.S. and B.J. Moulds, ♀ *C. suffusa* det. M.S. Moulds, Moul. Tully Falls, S of Ravenshoe, 11.i.1977, M.S. and B.J. Moulds, ♀ *C. suffusa* det. M.S. Moulds, Moul. Upper Smithfield, nr Cairns, 7.i.1984, M.S. and B.J. Moulds, ♂ *C. suffusa* det. M.S. Moulds, Moul. Windsor Tableland, NW of Mossmann, 10.i.1984, M.S. and B.J. Moulds, ♂ *C. suffusa* det. M.S. Moulds, Moul. Woobadda R., S of Bloomsfield, 13.i.1984, M.S. and B.J. Moulds, ♂ *C. suffusa* det. M.S. Moulds, ♀ *C. suffusa* det. M.S. Moulds, Moul.

Description. Body ochraceous to brown, probably green when alive and covered with short brown hairs (for photographs see Moulds, 1990: pl. 22 figs 7, 7a). Head and thorax with indistinct pattern of brown stripes. Females with conspicuously striped abdomen. Abdomen in males 1.4–1.6 x head and thorax together, in females 1.0–1.2 x. Tegmina of males 1.1–1.2 x body length, of females 1.3–1.4 x.

Head. With similar colour pattern as in *C. fumea*, though strongly varying in intensity. Vertex light brown, darker brown around lateral ocelli and sometimes around frontal ocellus and with dark brown spots bordering lateral corners of postclypeus. Vertex lobe with 2 dark brown spots between lateral ocellus and eye and a dark spot bordering proximomedial corner of eye.



Figures 25–37. 25–29, *Chlorocysta suffusa* Distant, 1907: 25, pygofer in lateral view, Julatten; 26, pygofer in oblique view, Julatten; 27, claspers and aedeagus, Julatten; 28, male caudodorsal beak in dorsal view, Julatten; 29, aedeagus in lateral view, Julatten.
30–37 *Owra insignis* Ashton, 1912: 30, pygofer in lateral view; 31, aedeagus in lateral view; 32, male caudodorsal beak in dorsal view; 33, male operculum; 34, female caudodorsal beak in dorsal view; 35, pygofer in oblique view; 36, clasper; 37, female operculum.

Vertex lobes slightly darkened on anterior parts. Postclypeus in dorsal view dark brown at lateral corners and along anterior margin. Ventral part of postclypeus with large dark medial spot. Lateral surface of postclypeus with 9–10 irregular rows of short parallel ridges continuing into ten parallel streaks running towards central fissure.

Thorax. Pronotum ochraceous brown, with a broad lighter ochraceous coloured medial band that is not, or only slightly, dilating towards distal pronotal margin. Proximal end of this band marked by a pair of small dark brown paramedian spots at pronotal collar. Pronotum light brown along oblique fissures and towards medial band. Mesonotum greyish brown, only slightly darkened in paramedian spots at pronotal margin and in vague reticulate pattern of angular brown spots, forming lateral streaks from pronotal margin to corners of cruciform elevation. Cruciform elevation greenish ochraceous, with brown medial band. 2 black spots in front of elevation.

Tegmina and wings: Hyaline. Tegmen venation variable, differing even between left and right tegmen of individuals. Tegmina with 12–13 apical areas and a, at some places double, band of 6–8 subapical areas. Wings with 5 apical areas.

Tymbals. 12 dark brown parallel sclerotized ridges; 8 ridges spanning the tymbal from dorsal to ventral margin, the 4 most proximal ridges do not reach ventral margin and successively shortening, with most proximal ridge shortest. 12 short and lighter coloured intercalary ridges seem to form a lateral band across tymbal.

Operculum. Male operculum (fig. 24) closely resembling that of *C. fumea* in size, but with a more rectangular shaped distal part, not elongated at distomedial corner. Basal part of operculum slighly vaulted and wedge-shaped; longest medially and tapering towards its lateral margin. Basal part forming a distinct, though very short crest around rectangular distolateral corner. Distal part of operculum almost rectangular, adjacent to body and not covering tymbal cavity in ventral view, though, as in *C. fumea*, covering most of folded membrane. The straight and almost parallel lateral and medial margins both making an almost right angle with straight distal margin. Meracanthus short, not reaching to distal margin of operculum. Female operculum (fig. 21) short, sickle-shaped and erect.

Abdomen. Male abdomen strongly inflated, almost uniformly brown to green coloured, segmental hind margins often darker coloured. Ventrolateral row of slightly darkened spots on segments 3–7. Female abdomen with pattern of broad longitudinal lateral streaks similar as in *Gymnotympana strepitans* (De Boer, 1995a) and a distinct dark brown ventromedial band. Female caudodorsal beak reaching to apex of ovipositor sheaths (fig. 22) and triangular in dorsal view, somewhat swollen to its base and sharply pointed at apex (fig. 23).

Male genitalia. Pygofer in lateral view (fig. 25) short and globularly rounded. Dorsal margin slightly concave, continuous with straight and slender caudodorsal beak. Distal margin slightly convex between beak and lateral protuberance. Ventral margin straight, but forming a rounded corner under lateral protuberance. Ventral margins converging and forming a sharp angle at base of pygofer opening (fig. 26). Caudodorsal beak in dorsal view (fig. 28) short, triangular and pointed or narrowly rounded at apex. Lateral lobe of pygofer curving inwards, forming a triangularly swollen protuberance, which does not extend beyond distal margin of pygofer. Claspers (fig. 27) very similar to *C. fumea*. Clasper base fused to a high and continuous collar around base of anal valves. Dorsal margin of clasper ending in right angle on this collar and not forming a crest on lateral surface of clasper base. Clasper base forming collar around base of anal valves, which abruptly, but slightly, curves inwards between claspers. Claspers forming diverging ridges from dorsal margins to base of anal valves. Distal corner of clasper bending mesiad around aedeagus, supporting aedeagus in upright position. Claspers curving down and strongly diverging towards apices. Apical part of clasper with sharply edged hollow at its inwardly directed side. Aedeagus apically rounded in lateral view (fig. 29), slender and Z-curved in apical third. Basal two-thirds of aedeagus almost straight, with very slender lateral crests and slightly swollen dorsally, at distal ends of lateral crests. Aedeagal apex with dorsoventral incision; aedeagus ending in two small, rounded, lateral lobes (fig. 27).

Measurements (mean ± sd): Body length ♂: 24.2–27.9 mm (26.2 mm ± 1.1), ♀: 20.0–21.5 mm (20.5 mm ± 0.6); tegmen length ♂: 28.2–31.2 mm (30.0 mm ± 1.1), ♀: 26.3–28.3 mm (27.5 mm ± 0.7); head length ♂: 2.1–2.5 mm (2.3 mm), ♀: 1.9–2.5 mm (2.2 mm); pronotum length ♂: 2.5–2.8 mm (2.7 mm), ♀: 2.7–2.8 mm; mesonotum length ♂: 5.4–6.4 mm (5.8 mm), ♀: 4.9–5.6 mm (5.3 mm); head width ♂: 6.0–6.7 mm (6.4 mm), ♀: 6.0–6.6 mm (6.3 mm); width of pronotal

collar ♂: 6.7–7.5 mm (7.0 mm), ♀: 6.6–7.3 mm (6.9 mm).

Distribution. Along the eastern coast of the Cape York Peninsula, Qld. Moulds (1990) recorded the species from Iron Range, the McIlwraith Range near Coen and Cooktown south to the Paluma Range.

Remarks. C. suffusa closely resembles *C. fumea* in tymbal shape and colour pattern but can be easily separated from that species by a dark brown suffused spot on the ventral side of the postclypeus. Males of *C. suffusa* are easily separated from *C. fumea* by their rectangular operculum.

Owra Ashton

Owra Ashton, 1912: 224. — Metcalf, 1963: 252. — Duffels and Van der Laan, 1985: 248. — Moulds, 1990: 184–185. — De Boer, 1992b: 18, 19, 20. — De Boer, 1993a: 16–17. — De Boer, 1993b: 142. — De Boer, 1995a: 8. — De Boer, 1995b: 6.

Type species. Owra insignis Ashton, 1912 (monotypic).

Owra insignis Ashton

Figures 30–37

Owra insignis Ashton, 1912: 224, pl. LI figs 6–6a. — Burns, 1957, 642. — Metcalf, 1963: 252. — Duffels and Van der Laan, 1985: 248. — Moulds, 1990: 185, pl. 22 figs 6, 6a.

Material examined. Australia, Lake Barine, 530 m, 31.i-1.ii.1964, J. Sedlacek, ♀, BPBM; Cairns, A.P. Dodd, ♂ Det. *Chlorocysta macrula* Stål, BPBM.

Description. Body reddish brown but according to Moulds (1990) olive green when alive (for photographs see Moulds, 1990: pl. 22 figs 6, 6a). Abdomen in male 1.5 x head and thorax together, in female 1.0 x. Tegmina of male 1.1 x body length, of female 1.4 x.

Tegmina and wings. Hyaline, venation red-brown and costa bright red. Tegmina with 10 (according to Moulds, 1990, sometimes 9) apical areas and a regular band of 3 or 4 subapical areas. Costal area very broad. Tegmen with very narrow hyaline border along hind margin. Wing with 5 apical areas and broad hyaline border along hind margin.

Tymbals. 5 parallel sclerotized ridges spanning the tymbal from dorsal to ventral margin and a 6th, most proximal ridge, almost reaching ventral margin. 5 distinct intercalary ridges seem to form a lateral band across tymbal.

Opercula. Male operculum (fig. 33) extremely small, not covering tymbal cavity in ventral view and leaving folded membrane completely exposed. Basal part of operculum about 4 x as long as distal part, slightly vaulted and with distinct crest around rectangular distolateral corner. Basal part wedge-shaped; medially distinctly longer than laterally. Distal part of male operculum very short, sickle-shaped and erect, hardly more than a continuation of the crest around distolateral corner of basal part. Meracanthus reaching well beyond operculum. Female operculum (fig. 37) very similar to that of male, with extremely short and sickle-shaped distal part.

Abdomen. Male abdomen slender and weakly inflated, almost unicoloured ochraceous, but segmental hind margins orange-brown. Second tergite (fig. 33) weakly curved along tymbal cavity. Female abdomen light brown with reddish segmental hind margins and ventrolateral row of brown spots on segments 3–8. Ovipositor sheaths not reaching to apex of caudodorsal beak. Female caudodorsal beak in dorsal view (fig. 34) broad and bluntly rounded at apex.

Male genitalia. Pygofer in lateral view as in fig. 30. Dorsal margin of pygofer straight, strongly concave to base and angularly bending into straight, slender and erect caudodorsal beak. Distal margin slightly convex, angularly bending into margin of beak. Lateral lobe of pygofer strongly curving inwards towards end of distal margin and forming an angularly rounded and swollen lateral protrusion. Ventral margin of pygofer strongly convex near this protrusion, but almost straight towards base of pygofer. Ventral margins converging to short and straight basal margin at base of pygofer opening (fig. 35). Caudodorsal beak in dorsal view (fig. 32) short and broad, truncate at apex. Claspers very different from those of related species, missing a clasper hollow. Clasper (fig. 36) broad, globularly swollen near base, strongly curved down to very slender and elongate, almost laminiform apical part. Claspers strongly diverging towards their truncate apices. Clasper base forming a low collar around base of anal valves. Aedeagus (fig. 31) strongly upcurved at half-length and with slender lateral crests. Aedeagal apex incised, as in *C. fumea* and *C. suffusa*, but ending in two more sharply pointed lateral lobes (fig. 35).

Measurements. Body length ♂: 15.1 mm, ♀: 13.3 mm; tegmen length ♂: 17.0 mm, ♀: 19.0 mm; head length ♂: 1.6 mm, ♀: 1.7 mm; pronotum length ♂: 1.6 mm, ♀: 1.8 mm; mesonotum length ♂: 3.0 mm, ♀: 3.3 mm; head width ♂: 4.1 mm, ♀: 4.6 mm; width of pronotal collar ♂: 4.0 mm, ♀: 4.6 mm.

Distribution. Only known from the south-eastern corner of the Cape York Peninsula, north-eastern Qld. Moulds (1990) recorded the species from Thornton Peak range north of Daintree to Mission Beach and widespread on the Atherton Tableland.

Remarks. Owra insignis is a very small ochraceous brown species, at first sight closely resembling *Guineapsaltria flava* and *Gymnotympana rufa. Owra*, however, is closely related to *Chlorocysta* and *Glaucopsaltria*, sharing the presumed synapomorphic tegmen venation. *Owra* shares the 5 apical areas in the wing with *Chlorocysta.* Only one male and one female have been examined.

Glaucopsaltria Goding and Froggatt

Glaucopsaltria Goding and Froggatt, 1904: 657, 659. — Moulds, 1990: 189 — De Boer, 1992b: 18, 19, 20. — De Boer, 1993a: 16–17. — De Boer, 1993b: 142. — De Boer, 1995a: 8. — De Boer, 1995b: 6.

Glaucopsaltria in synonymy of *Chlorocysta.* — Distant, 1906: 159. — Metcalf, 1963: 255–256, 473.

Type species. Glaucopsaltria viridis Goding and Froggatt (monotypic).

Glaucopsaltria viridis Goding and Froggatt

Figures 38–44

Glaucopsaltria viridis Goding and Froggatt, 1904: 566, 658. — Kirkaldy, 1907: 308 (6). — Moulds, 1990: 190, pl. 22 fig 3. — De Boer, 1995a: 16.

Chlorocysta viridis. — Distant, 1906: 159. — Froggatt, 1907: 352. — Burns, 1957, 643. — Metcalf, 1963: 256. — Duffels and Van der Laan, 1985: 249.

Material examined. Australia. Qld. 24.ii.1946, ♂, SEM. Brisbane. 1973, J.B. Vogel, ♂, ZMA. Qld. J.A. Grant, BM- CSIRO Expedition, BM 1973–346, ♂, BMNH. Rockhampton, Museum Godefroy No 4836, ♂ det. *C. viridis.* ZIM.

Description. Body olive green or yellow-green (for photograph see Moulds, 1990: pl. 22 fig 3). Tegmina slightly shorter than body. Abdomen 1.9–2.2 x head and thorax.

Tegmina and wings. Hyaline. Tegmen venation variable and differing even between left and right tegmen of individuals. Tegmina with 13–15 apical areas and a continuous band, at some places consisting of a double row, of 7–10 subapical areas. Costal area very distinct, broadening towards tegmen apex. Tegmen with distinct hyaline border along hind margin, though narrower than in wing. Wing with 6 apical areas.

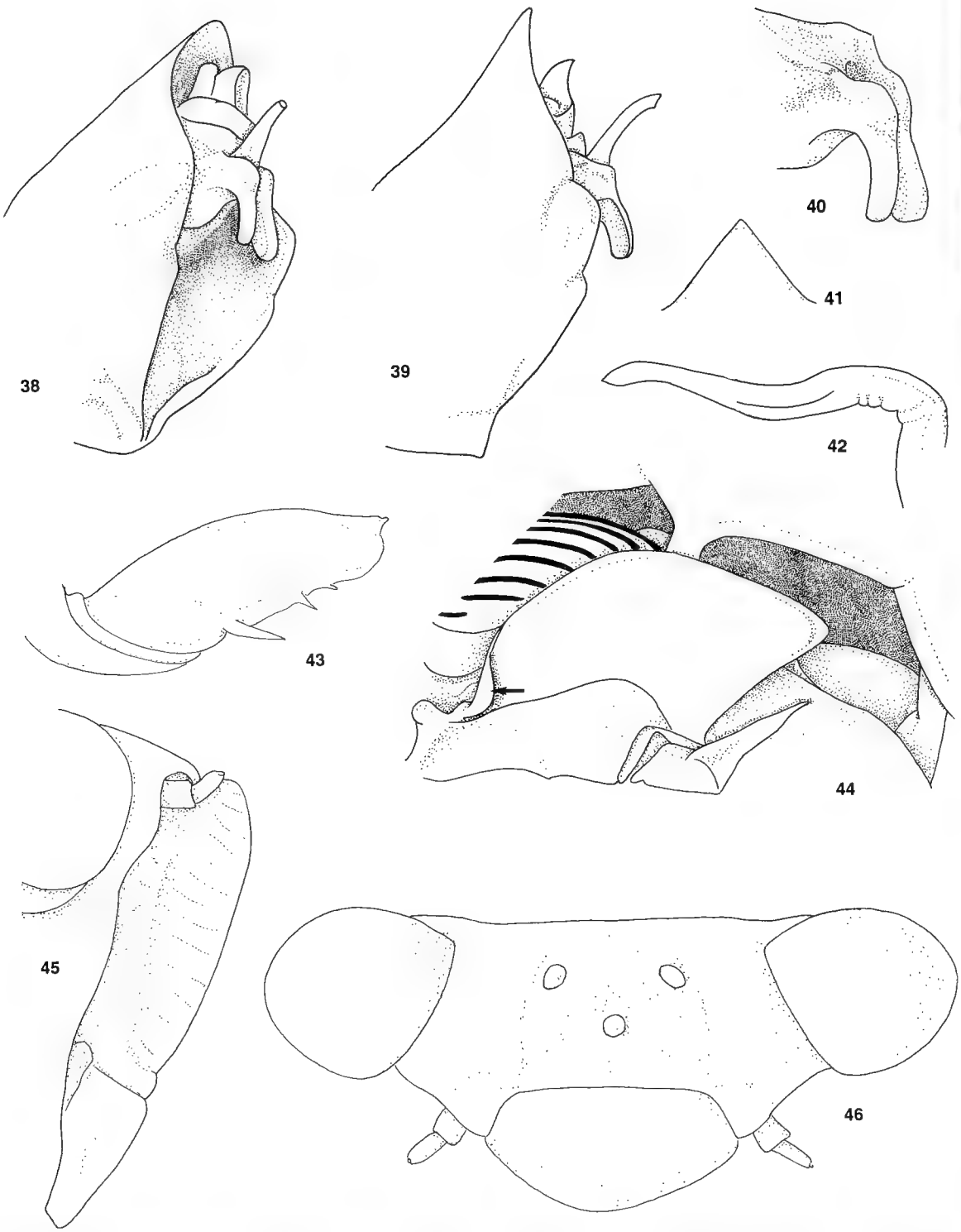
Legs. Fore femur with row of 3 erect spines (fig. 43).

Tymbals. 6 transverse sclerotized ridges spanning the tymbal from dorsal to ventral margin and a 7th, most proximal, ridge almost reaching ventral margin. 7 short intercalary ridges seem to form a lateral band across tymbal.

Operculum (fig. 44). Basal part of operculum slighly vaulted, wedge-shaped; longest medially and tapering towards lateral margin. Basal part forming an irregularly protruding crest around distolateral corner. Distal part of operculum longer than basal part and reaching beyond apex of meracanthus. Distal part only partly covering tymbal cavity in ventral view, though covering most of folded membrane. Lateral margin making an almost right angle with basal part of operculum and initially almost straihgt, but angularly bending mesiad where operculum curves towards body. Distal margin straight, making a sharp angle with straight medial margin. Distolateral corner broadly rounded. Operculum strongly curved-up along proximal part of its lateral margin (especially in Brisbane specimen), forming a small lobe (fig. 44 arrow).

Abdomen. Strongly inflated, uniformly green or discoloured yellow, with traces of green. Second tergite medially about 3 x 1st tergite and laterally gradually tapering to auditory capsules. Seventh tergite wedge-shaped in lateral view; very long and convex dorsally (lateral view), short ventrally.

Genitalia. Pygofer in lateral view as in fig. 39. Dorsal margin weakly concave, continuous with erect caudodorsal beak. Distal margin weakly convex between beak and lateral protuberance. Ventral margin straight, forming an almost rectangular corner just under lateral protuberance, concavely bent near base of pygofer opening. Ventral margins converge and form a sharp angle at base of pygofer opening (fig. 38). Caudodorsal beak in dorsal view (fig. 41) broad and triangular, almost rectangular at apex. Lateral lobe of pygofer bending inwards towards distal margin, forming an angularly rounded and laterally flattened protuberance. Clasper as in *Chlorocysta*, but with longer and more slender apical part (fig. 40). Apical part of clasper strongly bent down towards smoothly rounded apex and with a sharply edged hollow at inwardly directed side. Dorsodistal corner of clasper bending mesiad around aedeagus, supporting aedeagus in upright position. Claspers almost parallel, only slightly diverging towards apices and fused at base to a fairly low and continuous collar around base of anal valves. Medial part of collar curving inwards, slightly dome-shaped proximally of aedeagus, between



Figures 38–46. 38–44, *Glaucopsaltria viridis* Goding and Froggatt, 1904: 38, pygofer in oblique view, Australia; 39, pygofer in lateral view, Brisbane; 40, claspers, Australia; 41, caudodorsal beak in dorsal view, Australia; 42, aedeagus in lateral view, Australia; 43, male fore femur in lateral view, Australia; 44, operculum, Brisbane, arrow indicating upcurving lateral lobe. 45–46 *Venustria superba* Goding and Froggatt, 1904: 45, male postclypeus in lateral view, Kuranda; 46, male head in dorsal view, Kuranda.

dorsal crests of claspers. Dorsal margin of clasper forming a sharply edged crest, continuing on lateral surface of clasper base. Aedeagus (fig. 42) weakly S-curved, with very short and narrow lateral crests along proximal half. Aedeagal pore oval.

Measurements. (mean): Body length: 29.8–33.8 mm (32.1 mm); tegmen length: 29.5–31.3 mm (30.0 mm); head length: 2.1–2.4 mm (2.3 mm); pronotum length: 2.7–2.9 mm (2.8 mm); mesonotum length: 5.1–6.0 mm (5.5 mm); head width: 6.4–6.5 mm; width of pronotal collar: 6.8–7.0 mm (6.9 mm).

Distribution. Along the eastern coast of Qld and in north-eastern NSW. Moulds (1990) recorded the species from Daintree River punt crossing and Cairns in northern Qld, from Mackay, Carlisle Island, Middle Percy Island and Eungella in central Qld and from the Kolan River north of Gin Gin to Dorrigo.

Remarks. Glaucopsaltria viridis is larger than the *Chlorocysta* species with a strongly inflated abdomen. *Glaucopsaltria* is easily separated from *Chlorocysta* and *Owra*, since it has six (instead of five) apical areas in the wings. Males of *G. viridis* can be recognized by the shape of the 7th tergite which is very long middorsally but short ventrally so that the pygofer is curved to a ventral position. Females have not been examined. The local name of this species is Bottle Cicada (Moulds, 1990).

Venustria Goding and Froggat

Venustria Goding and Froggatt, 1904: 565, 596. — Distant, 1906: 128, 129. — Metcalf, 1963: 203. — Duffels and Van der Laan, 1985: 233. — Moulds, 1990: 32, 180. — De Boer, 1990: 64. — De Boer, 1991: 2–3. — De Boer, 1992a: 164. — De Boer, 1992b: 19. — De Boer, 1993a: 16–17. — De Boer, 1993b: 142. — De Boer, 1994a: 3. — De Boer, 1994b: 130. — De Boer, 1995a: 1, 3, 4, 8, 11. — De Boer, 1995b: 5.

Venustra [sic]. — Kato, 1932: 181.

Type species. Venustria superba Goding and Froggatt, 1904 (monotypic).

Remarks. Distant (1906) included *Venustria* in his division Taphuriaria (now the tribe Taphurini, which has as principal characters: "Eyes projecting beyond anterior margin of pronotum; pronotum subquadrate, not distinctly narrowed anteriorly; abdomen about as long as space between apex of head and base of cruciform elevation; a more or less distinct posterior metasternal process visible in males between or at the base of the opercula" (Distant, 1906). Recently Moulds (1990) transferred the genus to Chlorocystini since several characters (e.g., forewing vein Sc separated from costa; apical cells mostly longer than ulnar cells; and an inflated male abdomen) are "associated with that tribe".

Venustria has a weakly S-curved aedeagus, with very narrow lateral crests and should therefore be placed in Chlorocystini. The width of the head and shape of the pronotum of *Venustria* are very similar to those of *Chlorocysta* and its metasternum, though more protruding than in *Chlorocysta*, does not differ greatly from that of other genera of the tribe. Males of *Venustria*, however, have a very short and rather solid looking abdomen, often shorter than head and thorax together. The eyes are large and angular with inwardly directed proxomedial corners and the tegmina are relatively long so that in general aspect *Venustria* looks fairly different from all other species of the tribe.

Venustria superba Goding and Froggatt

Figures 45–55

Venustria superba Goding and Froggatt, 1904: 565, 597, 603, pl. xix figs 7, 7a. — Distant, 1906: 628. — Burns, 1957: 634. — Metcalf, 1963: 203–204. — Duffels and Van der Laan, 1985: 233. — Moulds, 1990: 180–181, pl. 16, fig. 11. — De Boer, 1995a: 3, 4, 9, 13, 15, 74, 77.

Material. Australia. Australiën, 1888, v Müller, ♀, SMN. Etty Bay nr Innisfail, 23.ii.1982, M.S. and B.J. Moulds, ♂ *Venustria superba* det. M.S. Moulds, ZMA. Cairns, J.F. Illingworth, 1920, 5♂, ♀ det. *Venustria superba*, BPBM. Kuranda 1 ml. E, 11.iii.1964, I.F.B. Common and M.S. Upton, ♂, CSIRO.

Description. Body light brown (for photograph see Moulds, 1990: pl. 16, fig. 11). Females about as long as males, but with more robust head and thorax and longer tegmina. Abdomen of males relatively short, 0.8–1.1 × head and thorax together, of females 0.9–1.0 ×. Tegmina fairly long in males and females, being 1.3–1.5 × body length.

Head (fig. 46): Ochraceous brown, darkened towards anterior margins of vertex lobes, with row of 3 dark spots on vertex lobe between lateral ocellus and eye. Head slightly broader than anterior part of pronotum, 2.4–3.1 × as broad as long and 2.1–2.4 × as broad as distance between eyes. Head distinctly shorter than distance between eyes. Postclypeus 2.6–3.2 × as wide as long and smoothly rounded anteriorly, its anterior margin convex and almost continuous with anterior margins of vertex lobes.

Figures 47–55. *Venustria superba* Goding and Froggatt, 1904: 47, female genital segment, Cairns; 48, female operculum, Cairns; 49, female caudodorsal beak in dorsal view, Cairns; 50, pygofer in lateral view, Kuranda; 51, pygofer in oblique view, Kuranda; 52, aedeagus in lateral view, Etty Bay; 53, male caudodorsal beak in dorsal view, Kuranda; 54, male fore femur in lateral view, Kuranda; 55, male operculum, Etty Bay.

Postclypeus (fig. 45) weakly swollen ventrally, anterior margin (lateral view) weakly convex. Lateral sides of postclypeus with about 12 furrows and 5–6 very short and irregular rows of short parallel ridges on weakly inflated crest along the lorum. Vertex smooth with weak medial furrow and without diverging furrows. Vertex in males 1.8–2.2 x, in female 2.3–2.4 × as wide as long and, in both sexes, 1.4–1.8 × as wide as width of eye. Eyes large and angular; medial margins of eyes strongly converging: shortest distance between eyes at their proxomedial corners. Ocelli small and wide apart. Distance between lateral ocelli 0.8–1.0 × distance between lateral ocellus and eye and 2.8–3.4 × width of frontal ocellus.

Thorax. Pronotum ochraceous, with dark streaks in and along oblique fissures and a narrow light ochraceous or greenish coloured medial band bordered by vaguely darkened streaks. Pronotum without medial fissure, 2.3–2.7 × as wide as long and, across the collar, 1.1–1.2 × as wide as head. Amplified lateral corners of pronotal collar larger than in *Chlorocysta*. Mesonotum ochraceous brown, with reticulate pattern of ochraceous stripes and brown specks, forming a pair of paramedian semicircular spots at pronotal margin and a pair of converging lateral bands from pronotal margin to corners of cruciform elevation. 2 dark spots in front of cruciform elevation.

Legs. Fore femur (fig. 54) with row of 3 erect spines, diminishing in length towards tibia. Most proximal spine very long, longer than distance to middle spine.

Tegmina and wings. Hyaline, but slightly bronzed in apical areas. Venation reddish brown. Tegmen with 9 apical areas and distinct costal area. Veins CuA and M adjacent, but not fused near basal area. Wing with 6 apical areas.

Tymbals. 4 transverse sclerotized ridges spanning the tymbal from dorsal to ventral margin, a 5th ridge almost reaching ventral margin and a 6th, most proximal, ridge spanning about three-quarters of tymbal width. 5 short intercalary ridges seem to form a lateral band across tymbal.

Opercula. Male operculum (fig. 55) covering greater part of tymbal cavity in ventral view and extending medially of meracanthus. Basal part of operculum medially distinctly longer than laterally, abruptly broadening at about third of its width and strongly vaulted. Distal part angularly oblong. Lateral margin long and straight, angularly bent into weakly convex distal margin. Distomedial and medial margins straight, distomedial corner broadly rounded, medial corner more narrowly rounded, almost rectangular. Meracanthus very short, hardly reaching beyond basal part of operculum. Opercula widely separated medially. Female operculum (fig. 48) very small. Basal part as in males, medially distinctly longer than laterally. Distal part shorter than basal part, its straight lateral margin forming a broadly rounded angle with weakly convex distal margin.

Abdomen. Light brown, silvery pilose and with dark brown midventral band. Males with darkened 8th and sometimes 7th, tergite and ventrolateral row of slightly darkened spots on segments 3–7. Male abdomen more solid in aspect than in other species of Chlorocystini, hardly swollen and almost without fold between tergites and sternites; nearly circular in cross section. First tergite very short and partly hidden under metanotum. Anterior margin of 2nd tergite concave medially. Lateral parts of 2nd tergite swollen anteriorly and almost adjacent to tymbal, leaving only a narrow gap between tymbal and 2nd tergite. Auditory capsules globularly swollen and distinctly elevated relative to connecting bar between abdomen and tymbal. Tergite part between auditory capsule and sternite 2 almost straight, with distinct crest along tymbal cavity. First sternite globularly swollen between opercula. Female abdomen about as large as that of male, but more strongly tapering towards apex. Female pygofer (fig. 47) long and slender with distinct thorn-shaped protuberance at ventral margin. Ovipositor sheaths reaching to apex of caudodorsal beak. Female caudodorsal beak in dorsal view (fig. 49) triangular and sharply pointed at apex.

Male genitalia. Pygofer in lateral view as in fig. 50. Dorsal margin almost straight, but concave to base and weakly convexly bent into stout and slightly posteriorly curved caudodorsal beak. Distal margin angularly convex, concavely bent into caudodorsal beak and ending in almost right angle on broad and angular lateral protrusion. Ventral margin strongly concave. Lateral lobe of pygofer with very small angularly swollen lateral protuberance, distinctly reaching beyond distal margin of pygofer. Pygofer opening broad (fig. 51); ventral margins ending wide apart at straight basal margin. Caudodorsal beak in dorsal view (fig. 53) triangular and sharply pointed at apex. Clasper (cf. fig. 51) very short and stout, with rounded lobate and downwardly directed apical part and broad, sharply edged inwardly directed, clasper hollow. Dorsal

margin of clasper sharply curving upwards proximally, merging with broad ring-shaped clasper base. Basal part of clasper very broad in lateral view, distinctly swollen around base of anal valves, especially mid-between claspers, possibly representing the remnants of a medial uncus lobe. Aedeagus (fig. 52) weakly S-curved, strongly swollen in proximal half and curving down towards apex. Aedeagus strongly widening near base, forming 2, somewhat lobate, basolateral protuberances flanking a large hollow at the fold between aedeagus and its basal plate. These protuberances continue into short lateral crests along proximal part of aedeagus. Aedeagus with very slender, almost membranous, laminiform ventrolateral crests, just medially of these lateral crests, which curve into the ventral hollow between the basolateral protuberances. Aedeagal pore almost round, weakly incised ventrally.

Measurements (mean ± sd): Body length ♂: 20.6–25.2 mm ($\bar{x}$23.4 mm ± 1.3), ♀: 23.4 and 26.2 mm; tegmen length ♂: 31.0–34.6 mm ($\bar{x}$33.5 mm ± 1.1), ♀: 35.1 and 35.3 mm; head length ♂: 2.4–3.1 mm ($\bar{x}$2.6 mm), ♀: 2.5 and 2.6 mm; pronotum length ♂: 2.9–3.6 mm ($\bar{x}$3.3 mm), ♀: 3.4 and 3.7 mm; mesonotum length ♂: 6.0–7.8 mm ($\bar{x}$7.0 mm), ♀: 6.8 and 8.0 mm; head width ♂: 6.7–7.7 mm ($\bar{x}$7.5 mm), ♀: 8.0 and 8.1 mm; width of pronotal collar ♂: 7.6–8.8 mm (8.5 mm), ♀: 8.8 and 9.2 mm.

Distribution. Endemic to the south-eastern corner of the Cape York Peninsula, north-eastern Qld. Moulds (1990) recorded the species from Mt Hartley approximately 30 km south of Cooktown to the Kirrama Range north-west of Cardwell.

Remarks. The species can be recognized by slightly bronzed tegmina with 9 apical areas. Males are characterised by short lobate claspers and females are easily recognized by the sharp, thorn-shaped, protuberance at the ventral margins of the pygofer (fig. 47). The local name of this species is Frog Cicada (Moulds, 1990).

Cystosoma and *Cystopsaltria*

Description. Body reddish brown, without any distinct colour markings. Surface of head and pronotum roughly wrinkled and pitted. Head and pronotum conically shaped; anterior margins of postclypeus and vertex lobes forming an almost continuous straight line with lateral margin of pronotum, though interrupted by eyes. Females smaller than males. Abdomen of males strongly inflated, being 1.3–2.0 × head and thorax, in females 0.9–1.1 ×. Male tegmen in *Cystosoma* 0.8–1.1 ×, in *Cystopsaltria* 1.4 × body length, in females 1.2–1.4 ×. Head (fig. 69) narrower than anterior part of pronotum, with long and angularly protruding postclypeus. Head 1.9–2.3 × as broad as long. Postclypeus distinctly protruding, its sharply edged anterior margin forming a right angle at apex. Postclypeus 1.6–2.1 × as broad as long, distinctly swollen ventrally (fig. 70), its anterior margin (lateral view) convex or forming an obtuse angle at half length. Lateral sides of postclypeus sometimes slightly bulbous, with about 9–12 weak furrows and a weakly inflated crest along lorum. Vertex wrinkled, with distinct medial fissure, but without diverging fissures between ocelli. Central part of vertex only slightly elevated, often even somewhat pressed down and concave. Vertex in *Cystopsaltria* narrower than in *Cystosoma*. Vertex 1.6–2.1 × as broad as long. Distance between eyes 0.9–1.1 × length of head and 1.1–1.4 × postclypeus width. Ocelli wide apart in *Cystosoma*, more closely together in *Cystopsaltria*. Distance between lateral ocelli 0.8–1.1 × distance between lateral ocellus and eye, and, in *Cystosoma* 2.4–3.7 ×, in *Cystopsaltria* 1.9–2.2 × width of frontal ocellus. Pronotum with grooved and pitted surface and distinct medial furrow. Amplified lateral corners of pronotal collar forming an inflated crest along anterior margin, which is continuous with the sharply edged anterolateral margin of pronotum. Mesonotum with a more smooth surface and with very narrow cruciform elevation, narrower than long across its centre. Fore femur (fig. 60) with row of 3 spines, diminishing in length towards tibia, most proximal spine strongly bent and adjacent to femur, reaching to about half-way the distance to middle spine (see arrow). Tegmina green, opaque rusty brown or greenish tinged in museum material, fairly slender and pointed at apex. Venation reticulate in distal half of tegmen. This reticulation includes ulnar areas in *Cystopsaltria*, but *Cystosoma* has normally developed ulnar areas. Costal area and border along hind margin of tegmen very narrow. Wings hyaline, in *Cystosoma* with 7–10, in *Cystopsaltria* with 12–14 apical areas, often somewhat reticulate near wing apex and with fairly broad hyaline border along hind margin. Tymbal with 6–10 transverse sclerotized ridges from dorsal to ventral margin. Male operculum fairly small. Basal part of operculum hardly vaulted, but in males forming a large, often globularly swollen, protuberance at distolateral corner. Distal part of male operculum angularly

oblong, curved to close against the body and covering most of tymbal cavity in ventral view. Opercula widely separated medially, by broad and rounded first sternite. Meracanthus short, not reaching distal margin of operculum. Female operculum shorter than that of male, with a more elongate lateral crest of basal part. Male abdomen very delicate and strongly inflated, without distinct folds between tergites and sternites; almost circular in cross section. First tergite in male fairly long, not hidden under metanotum. Proximal margin of second tergite convex medially and almost straight between auditory capsules and sternite 2 in *Cystosoma* (fig. 68), though weakly curved in *Cystopsaltria* (fig. 82) and forming a fairly distinct ridge along tymbal cavity. Lateral parts of 2nd tergite weakly swollen at anterior margins and adjacent to tymbals. Sternites 1 and 2 adjacent. Auditory capsules in males weakly developed, hardly protruding, but distinctly elevated relative to connecting bar between tymbal and abdomen. Female abdomen more robust than that of male, but much smaller with short and broad genital segment. Ovipositor sheaths not reaching to apex of bluntly rounded caudodorsal beak (fig. 63). Male pygofer globularly rounded, with short caudodorsal beak. Beak not curved over basal part of claspers or anal valves. Lateral lobes of pygofer curved inwards and forming bluntly rounded lateral protuberances. Claspers broad at base and hook-shaped; sharply curving down at half-length. Apical part of clasper with large, sharply edged, clasper hollow. Claspers weakly diverging towards rounded apices. Basal parts of claspers forming a continuous but very low ring-shaped collar around base of anal valves. Aedeagus weakly S-curved. Aedeagal pore round.

Tribal placement. Distant (1905) included *Cystosoma* in his division Hemidictyaria (presently tribe Hemidictyini) which has as its principal character a narrow head. This division also contained *Hemidictya* Burmeister, 1835, *Hovana* Distant, 1905 and seven genera that were later brought into the tribe Prasiini (e.g., *Arfaka* Distant, 1905; *Iruana* Distant, 1905; *Jacatra* Distant, 1905; *Lacetas* Karsch, 1890; *Lembeja* Distant, 1905; *Prasia* Stål, 1863 and *Sapantanga* Distant, 1905). Recently Moulds (1990) transferred *Cystopsaltria* from Chlorocystini to Hemidictyini based on the narrow head, inflated male abdomen and reticulate tegmina, characters very similar to *Cystosoma*.

A study of male genitalia, however, shows that *Cystosoma* and *Cystopsaltria* should be attributed to Chlorocystini (sensu stricto). *Cystosoma* and *Cystopsaltria* have a weakly S- curved aedeagus with winged lateral crests, the synapomorphy of that tribe. The shapes of pygofer and claspers also agree with such an allocation. Furthermore, for the discriminating characters used by Moulds, the inflated male abdomen of *Cystosoma* and *Cystopsaltria* is larger but otherwise very similar to that of most species of Chlorocystini and different from that of *Hemidictya*, and the head of *Cystosoma* and *Cystopsaltria* is not as notably different as that of several other genera of Chlorocystini.

Hemidictya frondosa Burmeister, 1835 and *Hovana distanti* (Brancsik, 1893), the two remaining species of the Hemidictyini, are undoubtedly closely related and probably sister species, interesting from a biogeographical point of view, since the former comes from Brazil and the latter from Madagascar. These two are characterised by (1) very broad, opaque yellow-green and apically pointed tegmina with reticulate venation in the distal halves, (2) a costa strongly widened and flattened in its proximal half, (3) a distally elongate and sharply pointed mesonotum reaching to the 2nd abdominal segment, and (4) a strongly streamlined head and pronotum, with anterior margins of postclypeus and vertex lobes forming a nearly straight and almost continuous line with margins of the eyes and lateral edges of pronotum. The last character is also found in the African genus *Lacetas* indicating that *Lacetas* should possibly be included in Hemidictyini.

Cystosoma and *Cystopsaltria* share opaque apically pointed and reticulate tegmina and a sharp lateral edge of the pronotum with *Hemidictya* and *Hovana*. Whether reticulate tegmen venation can be regarded synapomorphic is difficult to decide since its extent varies between the four genera. However, in general aspect the tegmina of *Hemidictya* and *Hovana* are very different from those of *Cystosoma* and *Cystopsaltria*. Tegmina of the former two are broader, more squarish and have a widened costa, while the veins CuA and M fuse well before reaching the basal area.

The sharp lateral edge of pronotum is definitely different, sharper, in *Hemidictya* and *Hovana*. Head and pronotum of these two species are more strongly streamlined than in *Cystosoma* and *Cystopsaltria*; even the eyes are flattened and contribute to this streamline. A lateral pronotum edge similar as in *Cystosoma* and *Cystopsaltria* was found in several other species of Chlorocystini (e.g., *Mirabilopsaltria*

viridicata (Distant, 1897), *M. humilis* (Blöte, 1960), *Gymnotympana montana* De Boer, 1995, *G. olivacea* Distant, 1905 and *G. verlaani* De Boer, 1995; see De Boer, 1995a; De Boer, 1995b, 1996).

Study of male genitalia of *Hemidictya frondosa* (unpublished) does not suggest relationship to Chlorocystini since there are considerable differences in shapes of pygofer, clasper and aedeagus between species of that tribe.

Monophyly. Cystosoma and *Cystopsaltria* are easily recognized by the following synapomorphies: apically pointed tegmina and venation reticulate in the distal halves of tegmina (1 and 2 in fig. 56). The hyaline wings too, tend to be somewhat reticulate towards their apices and have more than 6 apical areas. The species further share: 1, a very stout and angularly protruding postclypeus, in lateral view not unlike that of *Thaumastopsaltria*, but more strongly protruding and often with convexly swollen sides; 2, a sharp lateral edge of the pronotum in dorsal view, though interrupted by the eyes, almost continuous with the anterior margins of postclypeus and vertex lobes; and 3, a very slender cruciform elevation on the mesonotum, narrower than long across the centre. These characters also occur in Prasiini, the presumed sister group of Chlorocystini and might therefore be plesiomorphic.

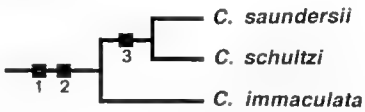


Figure 56. Cladogram of the species of *Cystosoma* and *Cystopsaltria*. Numbers refer to apomorphies discussed in the text.

Phylogeny. Although *Cystosoma schultzi* and *Cystopsaltria immaculata* share a fairly large male operculum, other characters indicate that *Cystosoma schultzi* and *Cystosoma saundersii* form a monophyletic group. The *Cystosoma* species have, compared to *Cystopsaltria*, a distinctly broader pygofer opening and a similar pattern of reticulation in the tegmina more restricted to the apical parts of tegmen. Furthermore, the veins CuA and M fuse at the corner of the basal area in *Cystosoma* (fig. 72), a probable synapomorphy for the two species of that genus (3 in fig. 56).

Cystosoma Westwood

Cicada Westwood, 1842: 118.

Cystosoma Westwood, 1842: 118. — Goding and Froggatt, 1904: 566, 595, 662. — Distant, 1906: 182, 185. — Metcalf, 1963: 433–434. — Boulard, 1979: 46. — De Jong, 1982: 182. — Duffels and Van der Laan, 1985: 315. — Moulds, 1990: 192. — De Boer, 1990: 64. — De Boer, 1992a: 164. — De Boer, 1992b: 18, 19. — De Boer, 1993a: 16–17. — De Boer, 1993b: 142. — De Boer, 1995a: 8, 12, 16. — De Boer, 1995b: 3.

Type species. Cystosoma saundersii Westwood, 1842.

Diagnosis. Head with flattened vertex and large, angularly protruding, postclypeus. Pronotum with distinct medial fissure and rough, pitted, surface. Tegmina opaque green, apically pointed. Tegmen venation reticulate, with many cross veins in apical areas, ulnar areas of normal shape. Veins CuA and M fusing at corner of basal area. Male abdomen strongly inflated.

Remarks. Cystosoma is presumed to be monophyletic, the fusion of the veins CuA and M at the corner of the basal area is the supposed apomorphy for the genus.

Cystosoma saundersii Westwood

Figures 57–68

Cicada saundersii Westwood, 1842: 118.

Cystosoma saundersii. — Westwood, 1842: 118. — Goding and Froggatt, 1904: 566, 662, 663. — Distant, 1906: 185. — Burns, 1957: 670. — Metcalf, 1963: 435. — Duffels and Van der Laan, 1985: 315. — Moulds, 1990: 193–196, pl. 23 figs 1, 1a–b. — De Boer, 1995b: 5.

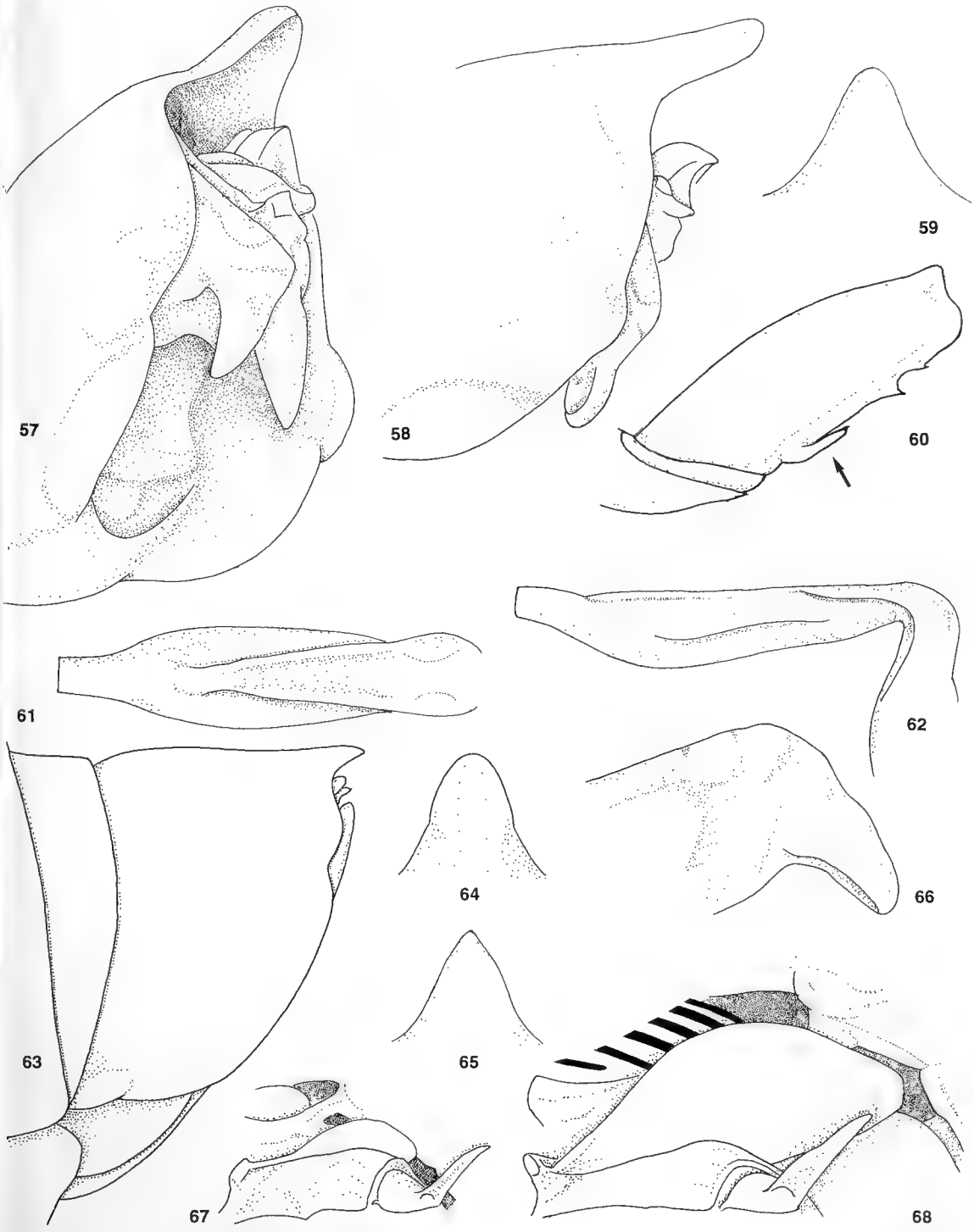
Cytosoma [sic] *saundersii.* — Musgrave, 1953: 13, 1 fig.

Cystosoma laundersii [sic]. — Schremmer, 1957: 19, Fig. 11, 46.

Material examined. Australia. Australia, Saunders, ♂, ♂ *Cystosoma saundersii* det. Edm. Schmidt, IZW, Brisbane, 1973, J.B. Vogel, 3♂, ZMA; Brisbane, Kenmore, xii.1972, J.B. Vogel, 3♂, ♀, ZMA. Cairns, 9 km W., ii-iv.1985, ♀, ZMA. Cunninghams Gap, 700–750 m, 20–30.xi.1963, J.L. Gressitt, ♂, ♀, BPBM. N. Holland, Koch, ♂, ♂ det. *Cystosoma saundersii* Westwood, ZMB. Nov. Holl., (Koch), v. Heyden, ♂ *Cystosoma saundersii* det. R.M. de Jong, SMF. NS Wales, 1908, coll. A. Jacobi, ♂, SMD; Qld, E.H.F. Walter, ♀, BPBM. Richmond river, NS Wales, 1908, Coll. A. Jacobi, ♂, SMD. Tully, New Holland, Camille van Voixem, ♂ det *Cystosoma saundersii* Westw., KBIN. Without locality label: Coll. Camille van Voixem, ♂, KBIN. Jocoli det. Coll. Breddin, ♂, DEI; ♂ *Cystosoma saundersii* det. R.M. de Jong, SMF. Without labels: ♂, ZMB.

Description. Body yellowish brown but green when alive, unmarked (for photograph see Moulds, 1990: plate 23 Figs 1, 1a-b). Abdomen in males 1.7–2.0 × head and thorax together, in females 0.9–1.1 ×. Tegmina of males 0.8–1.0 × body length, of females 1.2–1.3 ×.

Head. Greyish brown. Medial part of vertex hardly elevated, ocelli somewhat pressed



Figures 57–68. *Cystosoma saundersii* Westwood, 1842: 57, pygofer in oblique view, Tully; 58, pygofer in lateral view, Tully; 59, male caudodorsal beak in dorsal view, Tully; 60, male fore femur in lateral view, Tully, arrow indicating strongly bent proximal spine; 61, aedeagus in dorsal view, Brisbane; 62, aedeagus in lateral view, Brisbane; 63, female genital segment in lateral view, Cunningham's Gap; 64, female caudodorsal beak in dorsal view, Cunningham's Gap; 65, female caudodorsal beak in dorsal view, Brisbane; 66, clasper, Tully; 67, female operculum, Brisbane; 68, male operculum, Tully.

inward. Surfaces of vertex and dorsal part of postclypeus very rough, covered with small pits, anterior parts of vertex lobes wrinkled. Vertex and postclypeus with distinct medial fissure. Vertex with semicircular furrow around frontal ocellus, but without diverging fissures between ocelli. Postclypeus distinctly swollen ventrally, anterior margin (lateral view) angularly convex at about half-length. Sides of postclypeus with 11 weak furrows and a smooth and narrow, weakly inflated, crest along lorum.

Thorax, Pronotum pitted, smooth in medial furrow and with long wrinkles across collar. Mesonotum smooth and unmarked.

Tegmina and wings: Tegmina opaque green-brown and pointed at apex. Basal half of tegmen, including ulnar areas, with regular venation, distal half of tegmen reticulate, with many cross veins. Veins M and CuA fused at, or very close to, corner of basal area (cf. fig. 81). Wings hyaline, with irregular venation, 7 or 8 apical areas and 2 or 3 subapical areas. Apex of wing tending to be reticulate, with several cross veins in 1st, 2nd and sometimes 3rd apical area.

Legs, Fore femur (fig. 60) with 3 spines, most proximal spine strongly bent, adjacent to femur.

Tymbals, Large, in lateral view covering more than half of body width, 5 transverse sclerotized ridges spanning the tymbal from dorsal to ventral margin and a 6th most proximal ridge spanning about three-quarters of tymbal width. 6 distinct intercalary ridges form a lateral band across tymbal.

Opercula, Male operculum (fig. 68). Basal part of operculum with a knobby lateral protuberance at distolateral corner and weakly vaulted, lateral vaulting almost absent. Distal part of operculum rather large relative to basal part, almost as long as wide and almost completely covering tymbal cavity in ventral view. Distomedial corner of operculum extending medially beyond meracanthus. Lateral margin long, running straight to base of protuberance at distolateral corner of basal part and convexly bent into straight and about equally long, distal margin. Distomedial corner blunt, medial margin straight and slightly directed mesiad. Meracanthus reaching to about three-quarters of operculum length. Female operculum (fig. 67) narrower and much shorter than in male. Basal part of female operculum about as long as in male, but more distinctly vaulted and with long and distinct crest along rectangular distolateral corner. Distal part very short and erect, oblong, with almost rectangular distomedial corner and broadly rounded distolateral corner.

Abdomen. Ochraceous or green and unmarked. Male abdomen strongly, almost globularly inflated, distinctly broader than thorax and strongly convex dorsally; higher than thorax in lateral view. First tergite not extending under metanotum, more than half as long as 2nd tergite middorsally. Auditory capsules weakly inflated but distinctly elevated relative to connecting bar between tymbal and abdomen. Tymbal cavity very narrow; auditory capsules fairly close together and tergite part between auditory capsule and 2nd sternite very short. Second tergite straight between auditory capsule and 2nd sternite and forming a fairly distinct crest along tymbal cavity. Female abdomen long and slender, with conically protruding auditory capsules. Female pygofer (fig. 63) short and weakly swollen, in lateral view with weakly convex dorsal margin. Ovipositor sheaths not reaching to apex of caudodorsal beak. Female caudodorsal beak in dorsal view swollen triangular and pointed at apex (fig. 65) but rounded in specimen from Cunningham's Gap, southern Qld (fig. 64).

Male genitalia. Pygofer in lateral view as in fig. 58. Dorsal margin weakly convex, almost straight, continuous with straight caudodorsal beak. Distal margin weakly convex, concavely bent into straight margin of beak. Lateral lobe of pygofer slightly curving inwards and forming a weakly developed, slightly swollen and rounded lateral protuberance. Ventral margin forming a broad and rounded corner just below this protuberance and angularly convex, but concave towards pygofer base. Pygofer globularly swollen; pygofer opening very broad, broadest between lateral protuberances of pygofer lobes, ventral margins of pygofer converging to a convex basal margin at base of pygofer opening; ventral part of pygofer opening broadly U-shaped (fig. 57). Caudodorsal beak in dorsal view (fig. 59) very stout and broadly rounded at apex. Clasper (fig. 66) broad, square-shaped at base, with stout triangular, downwardly directed apical part, curving inwards distally of aedeagus and forming an angular dorsodistal corner supporting aedeagus in upright position. Claspers strongly diverging towards rounded apices. Apical part of clasper with distinct, sharply edged clasper hollow. Aedeagus (fig. 62) very stout and almost straight, slightly swollen and weakly upcurved at three-quarters of its length, but recurving towards apex. Aedeagus with very slender lateral crests and a pair of broad and

rounded dorsal ridges (fig. 61). Aedeagal pore broad and rounded.

Measurements (mean ± sd): Body length ♂: 42.0–51.0 mm (47.2 mm ± 2.6), ♀: 30.0–33.8 mm (31.3 mm ± 1.4); tegmen length ♂: 40.3–47.8 mm (43.9 mm ± 2.4), ♀: 37.7–42.2 mm (40.2 mm ± 1.7); head length ♂: 3.2–3.9 mm (3.5 mm), ♀: 3.4–3.9 mm (3.6 mm); pronotum length ♂: 4.2–4.8 mm (4.6 mm), ♀: 4.2–4.5 mm (4.4 mm); mesonotum length ♂: 7.0–8.3 mm (7.8 mm), ♀: 6.6–8.1 mm (7.4 mm); head width ♂: 7.1–7.8 mm (7.5 mm), ♀: 6.8–7.8 mm (7.4 mm); width of pronotal collar ♂: 10.8–11.9 mm (11.4 mm), ♀: 9.7–11.5 mm (10.7 mm).

Distribution. Eastern Qld and north-eastern NSW. Moulds (1990) recorded the species from the Atherton Tableland in northern Qld, the Clarke Range, Eungella plateau and Mackay in Central Qld, inland at Carnarvon Range and from Kroombit Tops in southern Qld to Sydney.

Remarks. Cystosoma saundersii is the largest species of Chlorocystini, easily recognized by its enormously inflated abdomen, hence the local name "Bladder Cicada" (Moulds, 1990).

Cystosoma schmeltzi Distant

Figures 69–71, 73–75, 81

Cystosoma schmeltzi Distant, 1882: 32, pl. vii figs 11, 11a-b. — Goding and Froggatt, 1904: 566: 662, 664. — Distant, 1906: 185. — Burns, 1957; 670. — Metcalf, 1963: 436. — Duffels and Van der Laan, 1985: 316. — Moulds, 1990: 192–193, pl. 23 figs 2, 2a.

Material. Australia. Dama, Cape York, ♀, ZMB; Gayndah, Mus Godefroy No 17630, ♀ paratype, ZIM. Wacol, 28.ii.1970, H. Sas, ♂, RMNH.

Description. Body yellow-green but green when alive and unmarked (for photographs see Moulds, 1990: pl. 23 figs 2, 2a). Male abdomen 1.4 × head and thorax together, in females 0.9–1.0 x. Tegmina of male 1.0 × body length, of females 1.4 x.

Head (fig. 69): Ochraceous with traces of olive green, vertex lobe with blackish spot between eye and lateral ocellus. Head heavily wrinkled between ocelli and on anterior parts of vertex lobes, vertex with distinct medial fissure. Postclypeus distinctly swollen ventrally, anterior margin (lateral view) angularly convex at about half-length. Lateral parts of postclypeus with 11 weak furrows and a smooth and narrow, weakly inflated, crest along lorum (fig. 70).

Thorax. Pronotum pitted as in *C. saundersii*, smooth in medial furrow and with long wrinkles on collar. Mesonotum smooth and unmarked.

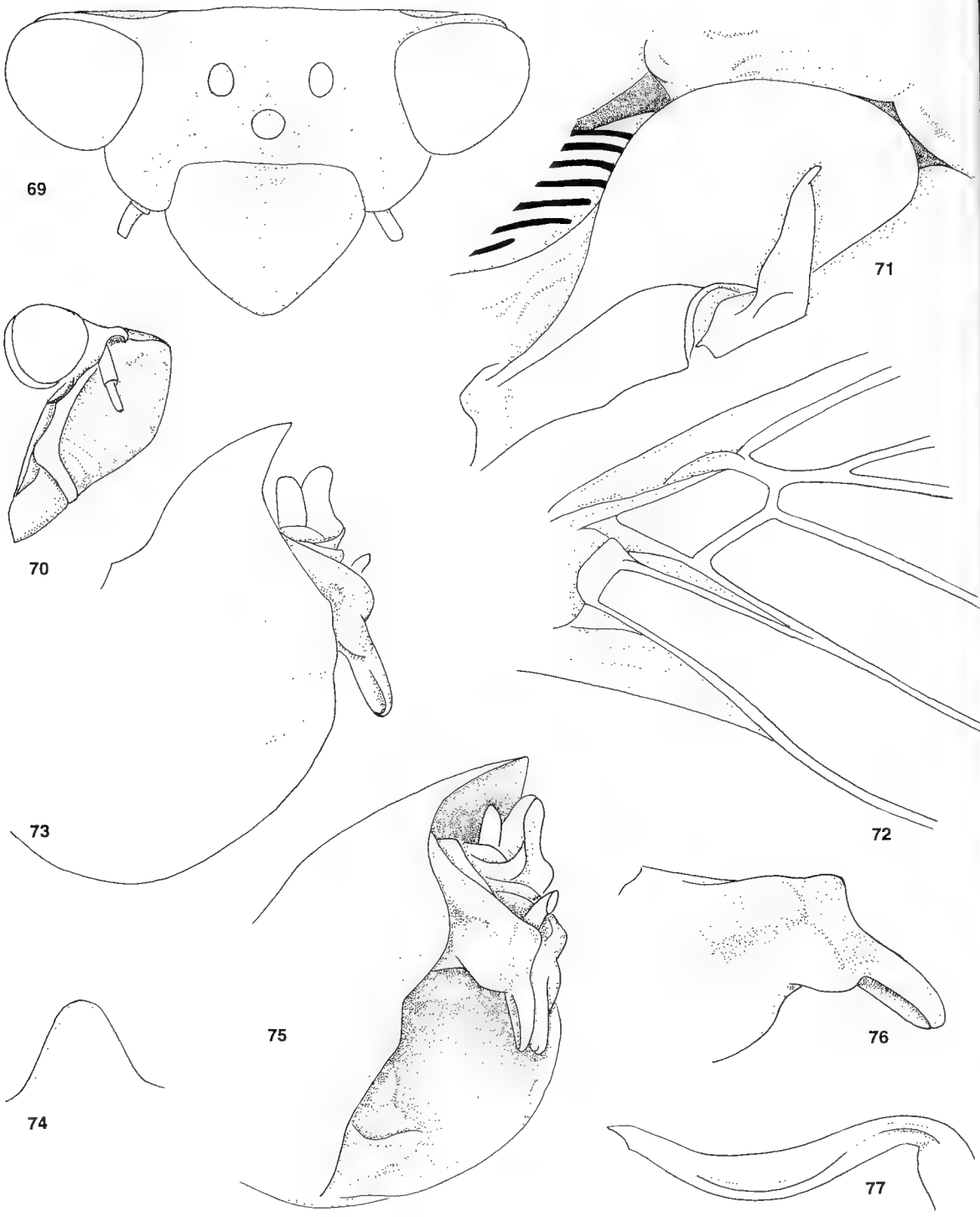
Tegmina and wings: Tegmina opaque green-brown and pointed at apex. Basal half of tegmen, including ulnar areas, with regular venation, apical half reticulate, with many cross veins. Veins M and CuA fused at corner of basal area (fig. 81). Wings hyaline, with almost regular venation and 7 apical areas. A fairly narrow hyaline border along hind margin of wing, though distinctly broader than opaque border of tegmen.

Tymbals. Large, in lateral view covering more than half of body width. 6 transverse sclerotized ridges spanning the tymbal from dorsal to ventral margin and a 7th most proximal ridge spanning about three-quarters of tymbal width. 7 distinct intercalary ridges form a lateral band across tymbal.

Opercula. Male operculum (fig. 71) with weakly vaulted basal part as in *C. saundersii*. Distal part of operculum very different from that of *C. saundersii*, oblong and rather large relative to basal part, completely covering tymbal cavity in ventral view and distinctly extending medially beyond meracanthus. Lateral margin long, gradually and concavely bending into crest around distolateral corner of basal part and convexly bending into long and weakly convex distal margin. Distomedial corner broadly rounded, medial margin straight. Meracanthus reaching to about two-thirds of operculum length. Female operculum as in *C. saundersii* with erect and oblong distal part (cf. fig. 67).

Abdomen. Male abdomen ochraceous to green and unmarked, distinctly inflated, but not as globular as in *C. saundersii*; with dorsal margin (lateral view) not distinctly elevated relative to dorsal margin of thorax. First tergite not hidden under metanotum and medially only slightly shorter than 2nd tergite. Auditory capsules weakly developed, hardly protruding and not visible in dorsal view, but distinctly elevated relative to connecting bar between tymbal and abdomen. Tymbal cavity very narrow; auditory capsules fairly close together and tergite part between auditory capsule and 2nd sternite very short. Second tergite straight between auditory capsule and 2nd sternite and forming a fairly distinct crest along tymbal cavity. Female genital segment short and weakly swollen as in *C. saundersii*. Ovipositor sheaths not reaching to apex of caudodorsal beak. Female caudodorsal beak in dorsal view swollen triangular and pointed at apex.

Male genitalia. Pygofer in lateral view as in fig. 73. Dorsal margin concave near base, but



Figures 69–77. *Cystosoma schmeltzi* Distant, 1882: 69, male head in dorsal view; 70, male postclypeus in lateral view; 71, male operculum; 72, base of right tegmen, male (*Cystopsaltria immaculata*); 73, pygofer in lateral view; 74, male caudodorsal beak in dorsal view; 75, pygofer in oblique view; 76, clasper; 77, aedeagus in lateral view.

strongly convex to apex of stout and short caudodorsal beak. Distal margin straight, forming an obtuse angle with margin of beak, angularly bending outwards at distal end, into weakly developed, slightly swollen and rounded lateral protuberance. Ventral margin weakly convex, but forming a broad and rounded inwardly curved corner just below this protuberance. Pygofer globularly swollen; pygofer opening very broad, broadest between lateral protuberances of pygofer lobes. Ventral margins converging to a very short and convex basal margin at base of pygofer opening; ventral part of pygofer opening U- shaped (fig. 75). Caudodorsal beak in dorsal view (fig. 74) very stout and broadly rounded at apex. Claspers (fig. 76) parallel to rounded apices, broad, square-shaped at base, with long and slender, downwardly directed apical part, curving inwards at angular dorsodistal corner and supporting aedeagus in upright position. Claspers fused at base to low collar around base of anal valves. Apical part of clasper with distinct but slender and sharply edged clasper hollow. Aedeagus (fig. 77) slightly upcurved, but recurving near apex, with very slender lateral crests and pair of broad rounded dorsal ridges. Aedeagal pore broad and oval.

Measurements. Body length ♂: 27.6 mm, ♀: 21.0 and 23.5 mm; tegmen length ♂: 28.2 mm, ♀: 29.0 and 32.3 mm; head length ♂: 2.7 mm, ♀: 2.7 and 2.8 mm; pronotum length ♂: 3.6 mm, ♀: 2.8 and 3.0 mm; mesonotum length ♂: 6.4 mm, ♀: 6.2 and 6.3 mm; head width: 5.4 mm, ♀: 5.3 and 5.5 mm; width of pronotal collar ♂: 8.0 mm, ♀: 7.5 and 7.9 mm.

Distribution. Eastern Qld and northern NSW. Moulds (1990) recorded the species from Mossman Gorge and Forty Mile Scrub, to inland northern NSW south to Gunnedah.

Remarks. C. schmeltzi is distinctly smaller than *C. saundersii* and has a less strongly inflated abdomen. The local name is "Lesser Bladder Cicada" (Moulds, 1990).

Cystopsaltria Goding and Froggatt

Cystopsaltria Goding and Froggatt, 1904: 559, 566, 661. — Distant, 1906: 154, 160. — Metcalf, 1963: 260. — Duffels and Van der Laan, 1985: 250. — Moulds, 1990: 196–197. — De Boer, 1992b: 18–19. — De Boer, 1993a: 16–17. — De Boer, 1993b: 142. — De Boer, 1995a: 8. — De Boer, 1995b: 3.

Type species. Cystopsaltria immaculata Goding and Froggatt, 1904.

Remarks. Cystopsaltria is a monotypic genus, closely related to *Cystosoma.*

Cystopsaltria immaculata Goding and Froggatt

Figures 72, 78–80, 82–87

Cystopsaltria immaculata Goding and Froggatt, 1904: 566, 661, pl. xvii figs 1, 1a. — Distant, 1906: 160. — Burns, 1957: 644–645. — Metcalf, 1963: 260. — Duffels and Van der Laan, 1985, 250. — Moulds, 1990: 197–198, pl. 23 figs 3, 3a.

Material. Australia. Cairns, 9 km W., ii-iv.1985, 3♀, ZMA. Kamerunga near Cairns, N. Qld., 10.i.1977, M.S. and B.J. Moulds, ♂, ZMA. Mt Windsor Tableland, NW of Mossman, 30.xii.1980, M.S. and B.J. Moulds, ♀ *Cystopsaltria immaculata* G. and F. det. M.S. Moulds, ZMA.

Description. Body light brown (for photographs see Moulds, 1990: pl. 23 figs 3, 3a). Male abdomen strongly inflated 1.3 × head and thorax together, in females 1.0–1.1 ×. Tegmina of male 1.4 × body length, in females 1.3–1.4 ×.

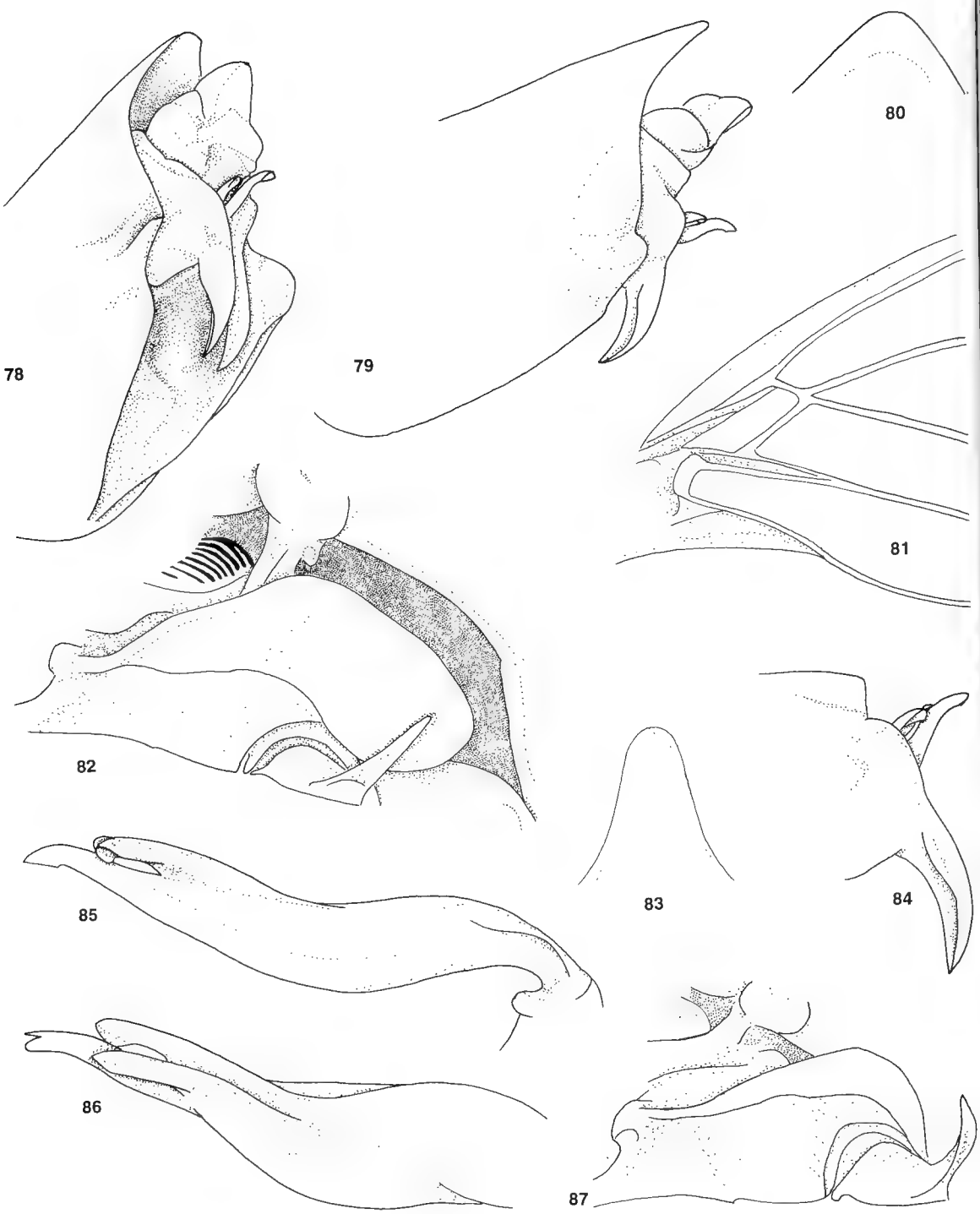
Head. As in *Cystosoma*, but with somewhat narrower vertex; ocelli more closely together. Distance between lateral ocelli 1.9–2.2 × width of frontal ocellus.

Thorax: Pronotum less distinctly pitted than in *Cystosoma*, in male smooth, but with a distinct medial furrow.

Tegmina and wings. Tegmina opaque greenish brown and reticulate as in the 2 foregoing species, but with very different pattern of veins. Distinctly more cross veins and larger part of tegmen reticulate; no regular ulnar areas. Veins M and CuA reach basal area separately. Radial area divided by extra vein, parallel to costa and fusing with vein M near corner of basal area (fig. 72). Tegmen with distinct, almost hyaline, cordial fold. Wings hyaline, with irregular venation as in *C. saundersii*, but with more (12–14) apical areas. Apex of wing tending to be reticulate, with several cross veins, especially near apex of first 4 or 5 apical areas.

Tymbals. Large, covering more than half of body width in lateral view. 8 transverse sclerotized ridges spanning the tymbal from dorsal to ventral margin, a 9th ridge spanning about three-quarters of tymbal width and a 10th most proximal ridge reaching to about half of tymbal width. 9 weak intercalary ridges form a lateral band across tymbal.

Opercula. Male operculum (fig. 82) resembling that of *C. schmeltzi*. Distal part of operculum oblong and rather large relative to basal part, covering greater part of tymbal cavity in ventral view and distinctly extended medially beyond meracanthus. Lateral margin long, forming an obtuse angle at about third its length,



Figures 78–87. *Cystopsaltria immaculata* Goding and Froggatt, 1904: 78, pygofer in oblique view; 79, pygofer in lateral view; 80, male caudodorsal beak in dorsal view; 81, base of right tegmen, male (*Cystosoma schmeltzi*); 82, male operculum; 83, female caudodorsal beak in dorsal view, Cairns; 84, clasper; 85, aedeagus in lateral view; 86, aedeagus in oblique view; 87, female operculum, Cairns.

angularly bending into crest around distolateral corner of basal part and angularly bending into long and weakly convex distal margin. Distomedial corner angularly rounded, medial margin weakly convex. Meracanthus reaching to about 3/4 of operculum length. Female operculum (fig. 87) much shorter than that of male. Distal part sickle-shaped, with angularly convex distal margin.

Abdomen. Ochraceous brown and unmarked. Male abdomen distinctly inflated, with its dorsal margin (lateral view) higher than dorsal margin of thorax. First tergite fairly short, middorsally less than quarter as long as 2nd tergite. Auditory capsules weakly developed, hardly protruding and not visible in dorsal view. Tymbal cavity much wider than in *Cystosoma*; tergite part between auditory capsule and 2nd sternite much longer than in that genus. Second tergite straight between auditory capsule and 2nd sternite and forming a distinct crest along tymbal cavity. Female abdomen as in *C. saundersii*. Ovipositor sheaths not reaching to apex of caudodorsal beak. Female caudodorsal beak in dorsal view (fig. 83) stout, bluntly rounded at apex.

Male genitalia: Pygofer in lateral view as in fig. 79. Dorsal margin almost straight and continuous with short caudodorsal beak. Distal margin straight, concavely bent into margin of beak, angularly bending outwards at distal end, into distinct and angularly swollen lateral protuberance. Ventral margin straight and forming a very small corner just below this protuberance. Pygofer opening much narrower than in *Cystosoma*. Ventral margins converging to a sharp angle at base of pygofer opening; ventral part of pygofer opening V-shaped (fig. 78). Caudodorsal beak in dorsal view (fig. 80) very stout and short, broadly rounded at apex. Claspers (fig. 84) almost parallel to sharply pointed apices. Clasper broad, square-shaped at base, with long and very slender, downwardly directed apical part, curving inwards at angular dorsodistal corner, supporting aedeagus in upright position. Claspers fused at base to a low collar around base of anal valves. Apical part of clasper with distinct but slender and sharply edged clasper hollow. Aedeagus (figs 85, 86) very stout, swollen and slightly upcurved in proximal half, but more slender in distal half and recurving near apex. Aedeagus without distinct lateral crests, but with a pair of broad rounded dorsal ridges, ending in weakly outcurving subapical appendages. Aedeagal apex incised.

Measurements (mean ± sd): Body length ♂: 35.0 mm, ♀: 31.5–35.1 mm (33.7 mm ± 1.4); tegmen length ♂: 40.0 mm, ♀: 42.3–46.6 mm (45.1 mm ± 1.7); head length ♂: 3.4 mm, ♀: 3.2–3.9 mm (3.7 mm); pronotum length ♂: 4.6 mm, ♀: 4.6–5.0 mm (4.8 mm); mesonotum length ♂: 7.9 mm, ♀: 7.6–8.5 mm (8.2 mm); head width ♂: 7.4 mm, ♀: 7.4–7.8 mm (7.6 mm); width of pronotal collar ♂: 10.6 mm, ♀: 10.4–11.5 mm (11.1 mm).

Distribution. North-eastern Qld. Moulds (1990) recorded the species from Gap Creek south of Cooktown to Paluma.

Remarks. C. immaculata is in size intermediate between *Cystosoma schmeltzi* and *C. saundersii*. The species is easily recognized by the reticulate vein pattern of tegmina, extending over a larger part of the tegmen than in *Cystosoma*. Males can be recognized by their aedeagus with distinct dorsal appendages.The local name is "Rare Bladder Cicada" (Moulds, 1990).

Acknowledgements

For the loan of material I am indebted to: Dr W.J. Knight and Mr M.D. Webb (BMNH); Mr G.M. Nishida and Mr K. Arakaki (BPBM); Dr B.P. Moore (CSIRO); Dr H. Gädike (DEI); Dr E. Kierich (IZW); Mr J. van Stalle (KBIN); Mr J. van Tol (RMNH); Dr V.P. Gapud (SEM); Dr R. Emmrich (SMD); Dr H. Schröder (SMF); Mr F. Heller (SMN); Dr H. Strümpel (ZIM); Dr U. Göllner-Scheiding and Dr J. Deckert (ZMB); Dr A. Jansson (ZMH). Mr M.S. Moulds is thanked for his help and cooperation and the loan of specimens from his private collection, he kindly donated some specimens of *C. immaculata* to our museum.

I would like to thank Mr G. Verlaan for technical assistance. I am indebted to Dr J.P. Duffels and Prof. Dr F.R. Schram (Instituut voor Systematiek en Populatie Biologie, Amsterdam) for their critical reading and comments on the manuscript.

References

Ashton, H., 1912. Some new Australian Cicadidae. *Proceedings of the Royal Society of Victoria (n.s.)* 24: 221–229, pls xlix–li.

Ashton, H., 1914. Catalogue of the Cicadidae in the South Australian Museum, with descriptions of several new species. *Transactions of the Royal Society of South Australia* 38: 345–358, pl. xvii.

Boer, A.J. de, 1990. *Aedeastria*, a new cicada genus from New Guinea, its phylogeny and biogeography (Homoptera, Tibicinidae), preceded by a discussion on the taxonomy of New Guinean Tibicinidae. *Beaufortia* 40 (3): 63–72.

Boer, A.J. de, 1991. *Scottotympana*, a new cicad genus from New Guinea, with the description of three new species, their taxonomy and biogeography (Homoptera, Tibicinidae). *Beaufortia* 42 (1): 1–11.

Boer, A.J. de, 1992a. The taxonomy and biogeography of the *viridis* group of the genus *Baeturia* Stål, 1866 (Homoptera, Tibicinidae). *Bijdragen tot de Dierkunde* 61 (3): 163–183.

Boer, A.J. de, 1992b. The taxonomy and biogeography of the genus *Thaumastopsaltria* Kirkaldy, 1900, (Homoptera, Tibicinidae). *Beaufortia* 43 (3): 17–44.

Boer, A.J. de, 1993a. *Guineapsaltria*, a new genus of the Australian-New Guinean region (Homoptera, Tibicinidae), with notes on its taxonomy and biogeography. *Bijdragen tot de Dierkunde* 63 (1): 15–41.

Boer, A.J. de, 1993b. Ten species added to the genus *Aedeastria* De Boer, 1990, with the description of eight new species and notes on the taxonomy and biogeography (Homoptera, Tibicinidae). *Beaufortia* 43 (9): 140–167.

Boer, A.J. de, 1994a. The taxonomy and biogeography of the *loriae* group of the genus *Baeturia* Stål, 1866 (Homoptera, Tibicinidae). *Tijdschrift voor Entomologie* 137: 1–26.

Boer, A.J. de, 1994b. The taxonomy and biogeography of the *exhausta* group of the genus *Baeturia* Stål, 1866 (Homoptera, Tibicinidae). *Beaufortia* 44 (5): 127–158.

Boer, A.J. de, 1994c. The taxonomy and biogeography of the *guttulinervis* group of the genus *Baeturia* Stål, 1866 (Homoptera. Tibicinidae). *Bijdragen tot de Dierkunde* 64 (2): 87–100.

Boer, A.J. de, 1995a. The taxonomy, phylogeny and biogeography of the cicada genus *Gymnotympana* Stål, 1861, (Homoptera, Tibicinidae). *Invertebrate Taxonomy* 9 (1): 1–81.

Boer, A.J. de, 1995b. The taxonomy and biogeography of the cicada genus *Papuapsaltria* gen. n. (Homoptera, Tibicinidae). *Tijdschrift voor Entomologie* 138: 1–44.

Boer, A.J. de, 1995c. Islands and cicadas adrift in the West-Pacific: biogeographic patterns related to plate tectonics. *Tijdschrift voor Entomologie* 138: 169–244.

Boer, A.J. de, 1995d. The phylogeny and taxonomic status of the Chlorocystini (Homoptera, Tibicinidae). *Bijdragen tot de Dierkunde* 65: 201–231.

Boer, A.J. de, 1996. *Mirabilopsaltria* a new cicada genus from New Guinea, its taxonomy and biogeography. (Homoptera, Tibicinidae). *Tropical Zoology* 9: 349–379.

Boulard, M., 1979. Révision de la faune cicadéenne des Iles Maurice et Rodrigues. *Bulletin de la Société Entomologique de France* 84: 27–47.

Burns, A.N., 1957. Check list of Australian Cicadidae. *Entomologische Arbeiten aud dem Museum Georg Frey* 8 (2): 609–678.

Daly, M.C., Cooper, M.A., Wilson, I., Smith, D.G. and Hooper, B.G.D., 1991. Cenozoic plate tectonics and basin evolution in Indonesia. *Marine and Petroleum Geology (MPGD)* 8 (1): 1–21.

Distant, W.L., 1882. On some undescribed Cicadidae from Australia and the Pacific Region *Proceedings of the Zoological Society of London* 1881: 125–134, pl. 7 figs 7–14.

Distant, W.L., 1905. Rhynchotal notes. — XXXIV. *Annals and Magazine of Natural History* (7) 16: 203–216.

Distant, W.L., 1906. *A synonymic catalogue of Homoptera. Part 1. Cicadidae.* Trustees British Museum: London.

Distant, W.L., 1907. Rhynchotal notes.- XLIII. *Annals and Magazine of Natural History* (7) 20: 411–423

Duffels, J.P., 1977. A revision of the genus *Diceropyga* Stål, 1870 (Homoptera, Cicadidae). *Monografieën van de nederlandse entomologische Vereniging* 8: 1–227.

Duffels, J.P., 1986. Biogeography of Indopacific Cicadoidea, a tentative recognition of areas of endemism. *Cladistics* 2 (4): 318–336.

Duffels, J.P. and Boer, A.J. de, 1990. Areas of endemism and composite areas in East Malesia. Pp. 249–272 in: Baas, P., Kalkman, C. and Geesink, R. (eds), *The plant diversity of East Malesia: Proceedings of the Flora Malesiana symposium commemorating Professor Dr. C.G.G.J. van Steenis, Leiden, August 1989.* Kluwer Academic Publishers: Dordrecht.

Duffels, J.P. and van der Laan, P.A., 1985. Catalogue of the Cicadoidea (Homoptera, Auchenorhynga) 1956–1980. *Series Entomologica* 34: i-xvi, 1–414.

Froggatt, W.W., 1907. *Sub-order ii.- Homoptera Australian insects.* William Brooks and Co.:Sydney. xiv + 449 pp.; pls 1–37.

Goding, F.W. and Froggatt, W.W., 1904. Monograph of the Australian Cicadidae. *Proceedings of the Linnean Society of NSW* 29 (3): 561–670; pls 18–19.

Hamilton, W.B., 1979. Tectonics of the Indonesian region. *United States Geological Survey Profesional Papers* 1078: i-ix, 1–345.

Holloway, J.D., 1979. A survey of the Lepidoptera, biogeography and ecology of New Caledonia. *Series Entomologica* 15: i-xii, 1–588.

Holloway, J.D., 1984. Lepidoptera and the Melanesian Arcs. Pp. 129–169 in: Radovsky, F.J., Raven, P.H. and Sohmer, S.H. (eds), *Biogeography of the tropical Pacific, proceedings of a symposium.* Association of Systematics Collection: Lawrence.

Jong, M.R. de, 1982. The Australian species of the genus *Lembeja* Distant 1892 (Homoptera, Tibicinidae). *Bijdragen tot de Dierkunde* 52 (2): 175–185.

Jong, M.R. de, 1985. Taxonomy and biogeography of Oriental Prasiini 1: The genus *Prasia* Sål, 1863 (Homoptera, Tibicinidae). *Tijdschrift voor Entomologie* 128: 165–191.

Kato, M., 1932. *Monograph of Cicadidae*. 450 pp. 32 pls.

Kato, M.,1956. *The biology of cicadas — Bulletin Cicadidae Museum*. Iwasaki Shoten, Jinbocho Kanda: Tokyo. 319 pp., 46 pls.

Kirkaldy, G.W., 1907. Some annotations to M. Distant's recent Catalogue of the Cicadidae. (Hem.). *Annales de la Société entomologique de Belgique* 51: 303–309.

Metcalf, Z.P.,1963. *General catalogue of the Homoptera, VIII. Part 2. Tibicinidae*. North Carolina State College: Raleigh. iv + 492 pp.

Moulds, M.S., 1990. *Australian cicadas*. NSW University Press: Kensington. 217 pp.

Musgrave, A., 1953. Seasonal occurrence of cicadas. *Australian Museum Magazine* 11: 10–15.

Pigram, C. J. and Davies, P.J., 1987. Terranes and the accretion history of the New Guinea orogen. *Journal of Australian Geology and Geophysics* 10: 193–212.

Rangin, G., Jolivet, L. and Pubellier, M.,1990a. A simple model for the tectonic evolution of the southeast Asia and Indonesia region for the past 43 m.y. *Bulletin de la Société géologique de France* (8) 6 (6): 889–905.

Rangin, G., Pubellier, M., Azema, J., Briais, A., Chotin, P., Fontaine, H., Huchon, P., Jolivet, L., Maury, R., Muller, C., Rampnoux, J.-P., Stephan, J.-F., Tournon, J., Cottereau, N., Dercourt, J. and Ricou, L.E., 1990b. The quest for Tethys in the western Pacific. 8 paleogeodynamic maps for Cenozoic time. *Bulletin de la Société géologique de France* (8) 6 (6): 907–913.

Schremmer, F., 1957.*Singzikaden Neue Brehmbücherei 193*. A. Ziemsen Verlag: Wittenberg-Lutherstadt. 47 pp.

Stål, C., 1863. Hemipterorum exoticorum generum et specierum nonnullarum novarum descriptiones. *Transactions of the Royal Entomological Society of London* (3) 1: 571–603.

Swofford, D.L., 1993. *PAUP: Phylogenetic Analysis Using Parsimony, version 3.1.1*. Illinois Natural History Survey: Champaign.

Walker, F., 1852. Supplement. *List of the specimens of Homopterous insects in the collection of the British Museum* 4: 1119–1188 [1119–1168], 8 pls. British Museum: London.

Walker, F., 1862. Characters of undescribed species of Homoptera in the collection of F.P. Pasco, F.L.S. *Journal of Entomology* 1 (5): 303–319, pl. 15.

Westwood, 1842. Illustrations of some genera belonging to the family Cicadidae. Vol. 1 (6), pp. 81–96, pls xxi-xxiv in: Westwood, J.O., *Arcana entomologica; or illustrations of new, rare and interesting exotic insects*: Will. Smith: London.

Westwood, J.O., 1851. Descriptions of some new species of exotic homopterous insects. Vol. 1, Appendix D, pp.432–434, pl. 4 in: Eyre, E.J., *Journals of expeditions of discovery into Central Australia and overland from Adelaide to King George's Sound*. Boone: London.

Memoirs of the Museum of Victoria 56(1):125–128 (1997)

THE TYPE SPECIES OF *ALEURODICUS* DOUGLAS, A WHITEFLY GENUS OF ECONOMIC IMPORTANCE (HOMOPTERA: ALEYRODIDAE)

J.H. Martin

Department of Entomology, The Natural History Museum, Cromwell Road, London SW7 5BD, UK

Abstract

Martin, J.J., 1997. The type species of *Aleurodicus* Douglas, a whitefly genus of economic importance (Homoptera: Aleyrodidae). *Memoirs of the Museum of Victoria* 56(1): 125–128.

Slides prepared from type specimens of *Aleurodicus cocois* (Curtis), held in the Museum of Victoria, Australia, have allowed their microscopic examination, possibly for the first time. A lectotype is designated and an updated species diagnosis is presented. Its status as the type species of *Aleurodicus* is confirmed through validation of its synonymy with *A. anonae* Morgan.

Introduction

Aleurodicus Douglas (in Morgan, 1892) is the type genus of the mostly Neotropical whitefly subfamily Aleurodicinae. It includes several agricultural pest species, most notably *A. dispersus* Russell (1965), a polyphagous and extremely fecund species. This insect has gained particular notoriety by extending its native New World distribution to encompass much of the Pacific, southern Asia and Africa over a period of only 15–20 years, arriving in northern Queensland by 1995 (Martin, 1996). A few *Aleurodicus* species are natives of southern Asia and the western Pacific; *A. destructor* Mackie (1912) is one of this group, occasionally becoming a pest in tropical Australia.

As part of a study of economically important members of the Aleurodicinae in the Caribbean region, it was discovered that Mound and Halsey (1978) had mistakenly credited the Natural History Museum, London (BMNH) as the depository of syntypic specimens of *Aleurodicus cocois* (Curtis, 1846). *A. cocois* has been regarded as the type species of *Aleurodicus* through synonymy (see below) and the purpose of this investigation has been to locate and examine type material in order to assess this status. *A. cocois* was described from coconut in Barbados but material with the relevant data was absent from BMNH. However five slides from Demerara [Guyana] in BMNH, identified as *A. cocois*, bear red labels as if of type status. This Guyanese material may have mistakenly been used as the basis for proposing the synonymy of *A. anonae* Morgan with *A. cocois* (see Discussion, below). Thus it was necessary to locate and examine the true type material of *A. cocois* in order to reappraise this important synonymy.

Depositories. BMNH — The Natural History Museum, London SW7 5BD, UK

NMV — Museum of Victoria, Abbotsford, Melbourne, Vic. 3067, Australia

USNM — United States National Museum of Natural History, Washington DC 20560, USA

Aleurodicus cocois (Curtis)

Figures 1–2

Aleyrodes cocois Curtis, 1846: 284–285. Lectotype here designated

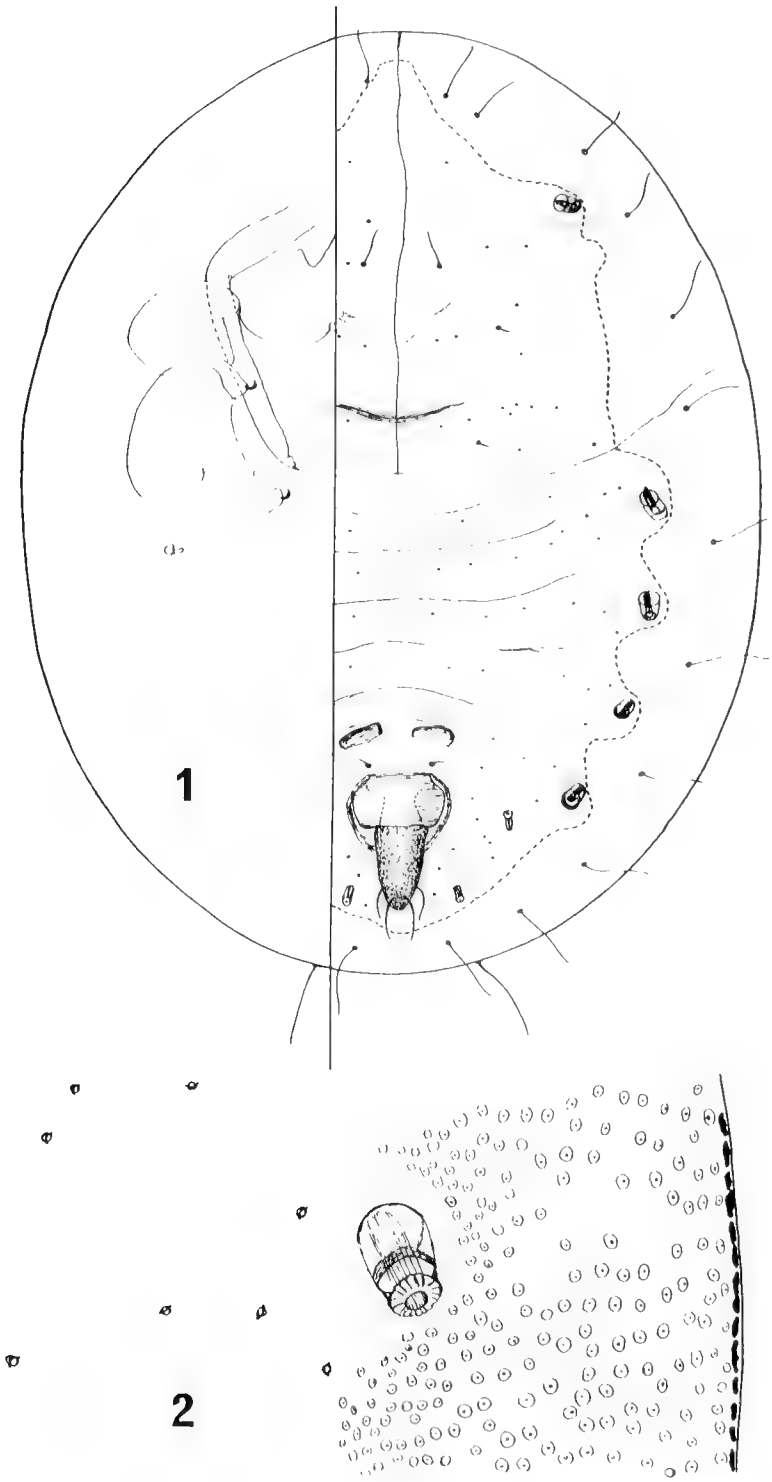
Aleurodicus anonae Morgan, 1892: 32 (Lectotype designated and synonymised with *A. cocois* by Mound and Halsey, 1978: 229).

Aleurodicus cocois (Curtis) Morgan, 1892:32.

Type material examined. Lectotype puparium of *Aleyrodes cocois* Curtis **(here designated)**: Barbados, on coconut tree [*Cocos nucifera*], Sir R Schomburgk, January 1845 (NMV). Paralectotypes of *A. cocois*: 12 puparia, 2 third instar larvae, Barbados, same data as lectotype (NMV, BMNH, USNM). Additional material of *A. cocois*: 1 male, 1 female adult (on 1 slide), several dry adults in rather poor condition and further puparia and third instar larvae on leaf fragments, Barbados, same data as lectotype (all NMV).

Lectotype and paralectotype of *Aleurodicus anonae* Morgan: 2 puparia, Guyana, Demerara, on *Annona muricata*, S.J.McIntire (Douglas collection 1236), 1891 (BMNH).

Diagnosis. Pupal case. Rather evenly oval outline, widest at abdominal segment II, usually 1.00–1.40 mm long, 0.70–1.00 mm wide. Submargin with a broad band of wide-rimmed simple pores (terminology of Russell, 1965); inner margin of this band is very characteristic, on meso- and meta-thorax almost straight and parallel to longitudinal moulting suture (Fig.1), but on abdomen curling around the large compound pores (Figs 1, 2). Dorsal surface mesad of wide-rimmed pore band smooth, punctuated only by scattered septate pores (Fig. 2).



Figures 1, 2. *Aleurodicus cocois*, puparium (after Martin, 1987). 1, whole puparium, dorsal detail to right of line, boundary of submarginal wide-rimmed pore band shown as dashed line; 2, dorsal detail of abdominal segments II/III to show submarginal wide-rimmed pores, scattered subdorsal septate pores and large compound pore in lateral aspect.

Cephalic and anteriormost 4 pairs of abdominal compound pores usually 25–30 µm in diameter, posteriormost 2 abdominal pairs no more than 12 µm (in all cases measured as the width of the cylinder when pores in lateral aspect).

Distribution and host plants. Widely distributed in New World tropics. Usually colonising coconut but host records from 14 plant families are quoted by Mound and Halsey (1978). Material in BMNH from hosts other than Palmae comprises samples from Anacardiaceae, Annonaceae and Lauraceae.

Discussion

Horn et al. (1990) indicated that the collection of John Curtis (who published entomological notes in Gardener's Chronicle under the pseudonym "Ruricola") had been deposited largely in the Museum of Victoria, Melbourne. Ken Walker (pers. comm.) confirmed that the dry material sent to Curtis from Barbados was indeed present in Melbourne, but that no slides appeared to have been made. This dry material, the syntypes of *Aleyrodes cocois*, was kindly loaned to the author. Slides were prepared which have verified that the considerable numbers of specimens in BMNH, identified as *A. cocois* over the years, are conspecific with the type material.

The red-labelled Guyanese specimens in BMNH are also from coconut. They bear J W Douglas's collection number 1246/27, and one slide bears the following note, in Laurence A. Mound's handwriting: "The specimens referred to in Morgan 1892 as from JWD ex-Demerara — see Douglas diary". Consultation of Douglas's diary (BMNH archive) reveals that batch 1246 comprised a number of samples received from Mr S J McIntire in Demerara, 12 October 1891. Sample 27 bears the note "'small fly and fluff found on a cocoanut tree, alive when sent'. *Aleurodes cocois*, Curt. true and diff. from that on *Anona* (sic), no.1236. Those sent alive in a bottle, to Mr Morgan".

Morgan's (1892) paper is confusing and rambling but is of great importance because it was the vehicle for establishment of the genus *Aleurodicus*, which contains several species of great economic significance. "*Aleurodicus* Douglas n.g." was proposed in the middle of Morgan's paper, with an extremely brief diagnosis as a footnote, initialled "J W D". Immediately under the generic heading is Morgan's own description of his new species *Aleurodicus anonae*, although this was only subsequently designated as the type-species of *Aleurodicus*, by Quaintance (1908).

A. cocois is discussed in several places in Morgan's 1892 paper, and the coconut sample detailed in the Douglas diary is mentioned twice, most particularly "Habitat: cocoa-nut palm only, Demerara". However, the fact that Curtis had described *A cocois* from Barbados is nowhere mentioned, even though Morgan acknowledged McIntire for providing him with a copy of Curtis's descriptive article, sections of which Morgan quoted. I believe that this has been the source of major confusion. Quaintance (1908) quoted *A. cocois* as "also [described] from Demerara" (along with *anonae*), and yet he included Barbados in its distribution data. Although no particular status is claimed on the red labels of the BMNH slides, it is probable that Mound and Halsey, too, attributed unwarranted significance to this Guyanese coconut material from the Douglas collection.

Conclusions

From examination of the type material of *A. cocois* and *A. anonae* the author concludes that *A. anonae* is correctly placed as a junior synonym of *A. cocois*, which is thus the type species of *Aleurodicus* Douglas. Specimens on red-labelled BMNH slides of *A. cocois* from coconut in Demerara, which had been sent by McIntire to Douglas and forwarded to Morgan, were certainly compared by Morgan with other Guyanese material he subsequently described as *A. anonae*: however, they have no type status nor particular significance taxonomically, having only been identified as *A. cocois* through comparison with Curtis's written description.

Acknowledgements

The assistance of Ken Walker (NMV), who swiftly located the Curtis dry material and kindly arranged for its loan to BMNH, is gratefully acknowledged. The author's thanks are also extended to Doug Williams and Gillian Watson (CAB International Institute of Entomology), for helpful suggestions made during this investigation.

References

Curtis, J. (as "Ruricola"), 1846. *Aleyrodes cocois* (the cocoa-nut Aleyrodes). *Gardener's Chronicle* 1846: 284–285.

Horn, W., Kahle, I., Friese, G. and Gaedike, R., 1990. *Collectiones Entomologicae*. Berlin. 573 pp.

Mackie, D.B., 1912. A new coconut pest. *Philippine Agricultural Review* 5: 142–143.

Martin, J.H., 1987. An identification guide to common whitefly pest species of the world. Tropical Pest Management 33(4): 298–322.

Martin, J.H., 1996. Neotropical whiteflies of the subfamily Aleurodicinae established in the western Palaearctic (Homoptera: Aleyrodidae). *Journal of Natural History* 30(12): 1849–1859.

Morgan, A.C.F., 1892. A new genus and species of Aleurodidae. *Entomologist's Monthly Magazine* 28: 29–33.

Mound, L.A. and Halsey, S.H., 1978. *Whitefly of the world*. Chichester. 340 pp.

Quaintance, A.L., 1908. Homoptera, Family Aleyrodidae. In Wytsman, P. [ed.], *Genera Insectorum* 87: 1–11.

Russell, L.M., 1965. A new species of *Aleurodicus* Douglas and two close relatives (Homoptera: Aleyrodidae). *Florida Entomologist* 48: 47–55.

Memoirs of the Museum of Victoria 56(1):129–143 (1997)

ADDITIONS TO THE TAXONOMY OF THE LIMNORIIDAE (CRUSTACEA: ISOPODA)

L.J. Cookson

CSIRO, Forestry and Forest Products,
Private Bag 10, Clayton South MDC, Vic. 3169, Australia

Abstract

Cookson, L.J., 1997. Additions to the taxonomy of the Limnoriidae (Crustacea: Isopoda). *Memoirs of the Museum of Victoria* 56(1): 129–143.

The crustacean marine wood borers *Paralimnoria andrewsi* (Calman) and *Limnoriasaseboensis* Menzies are described from Australia for the first time. New characters are listed that will aid in the separation of *L. saseboensis*, *L. indica* Becker and Kampf, *L. simulata* Menzies and *L. foveolata* Menzies. *L. indica* and *L. simulata* are considered to be separate species. *Limnoria carptora* sp. nov. is described from algal holdfasts growing at Heard Island in the subantarctic. Additional distribution and habitat records are provided for *L. agrostisa* Cookson, *L. convexa* Cookson, *L. loricata* Cookson, *L. platycauda* Menzies, *L. quadripunctata* Holthuis, *L. rugossisima* Menzies, *L. unicornis* Menzies, and *Lynseia annae* Cookson and Poore.

Introduction

This paper adds to an earlier study (Cookson, 1991) on the taxonomy of the Limnoriidae, an isopod crustacean family of wood-, algal- and seagrass-boring species. Since that publication the Lynseiidae, a supposedly related family, has been dismantled and its species of *Lynseia* transferred to Limnoriidae (Cookson and Poore, 1994), so that with *Limnoria* and *Paralimnoria* there are now three genera in the family. Extensive ecological research in Western Australia has shown that the seagrass-boring species of *Lynseia* and *Limnoria agrostisa* Cookson can heavily colonize seagrass meadows, with possibly important implications for the health of those ecosystems (Brearley and Walker, 1993).

The present contribution re-examines the species *Limnoria indica*, *L. saseboensis*, *L. simulata* and *L. foveolata* in an effort to clarify distinguishing features. All four are very similar in appearance, and indeed, Müller (1988) synonymised *L. indica* and *L. simulata*. Also, a new species is described from the subantarctic, and the distribution or habitat records for a further nine species extended (Table 1).

Material for this study was obtained from the Museum of Victoria, Melbourne (NMV); Australian Museum, Sydney (AM); United States National Museum of Natural History, Washington D.C. (USNM); Zoologisk Museum, Copenhagen (ZMUC); Canterbury Museum, Christchurch (CM); and the Bundesanstalt für Materialforschung und -Prüfung (BAM).

Limnoria agrostisa Cookson

Limnoria agrostisa Cookson, 1991: 166–167, 169, fig 10. — Cookson, 1990: 6, 15. — Brearley and Walker, 1993: 415–428, fig 1a.

Material examined. SA, Port Pirie (33°12′S, 138°00′E), 4.1 m, subtidal on *Posidonia* and *Amphibolis* spp: core sample 795-A4/5, T.J. Ward, Aug 1979, AM P38958 (male, 3.75 mm), core sample 801-A4/8, T.J. Ward, Mar 1980, AM P38986 (female, 2.9 mm).

WA, Bramble Point, Princess Royal Harbour (35°03′S, 117°53′E), on *Posidonia sinuosa*, airlifted sample epifauna, 0.1 m^2, Hutchings, Wells and Walker, 20 Jan 1988 (stn P. sinuosa 10), AM P39019 (ovig. female 4.0 mm). Green Island, Rottnest, 1–2 m, from *Amphibolis griffithii*, D.I. Walker, 7 Feb 1989, NMV J37418 (female, with 1 slide, 3.0 mm), NMV J37420 (4 females, 1 male, 2 juv), 6 Feb 1989, NMV J37419 (male, 1.7 mm). Seven Mile Beach, near Dongara, G. Edgar, 1985–1986, NMV J37421 (male, with 1 slide, 2.0 mm).

Previous distribution records. South Australia and southern Western Australia.

Remarks. L. agrostisa was originally described on the basis of just two specimens. In this additional material, one large male from Port Pirie (AM P38958) has a pair of relatively large anterior puncta on the pleotelson, similar in comparative size to that found on *L. unicornis* males, but not recurved. The male sometimes has pereopod 7 poorly developed (NMV J37420, J37421).

While *L. agrostisa* has been collected from *Posidonia*, its preferred substrate is *Amphibolis griffithii* (Brearley and Walker, 1993).

Table 1. New distribution records or substrates for the Limnoriidae.

Species	Existing distribution record	Location *new record	Substrate *new record	Museum material
Paralimnoria andrewsi (Calman)	Christmas Islands. Samoa. Hawaii. Japan. Florida. Caribbean. Philippines. Puerto Rico. Ghana. Papua New Guinea. Cocos Islands.	Broome*, Australia	Jarrah heartwood*	NMV J17259
Lynseia annae Cookson & Poore	Geraldton to Dunsborough, Western Australia. Ceduna, South Australia.	Corner Inlet, Victoria*	*Posidonia australis*	NMV J41054
Limnoria convexa Cookson	The Snares, New Zealand	Campbell Island*, New Zealand	*Durvillaea* holdfasts	NMV J37422 NMV J37423 CM 5.37
Limnoria indica Becker & Kampf	Northern Queensland, Australia. Papua New Guinea. Admiralty Islands. Mandapam Camp, Andaman Islands, India. Hong Kong. Manila, Philippines. Koniya, Japan. Penang, Malaysia. Belize. Tobago.	Gladstone*, Queensland (southern limit). Madras*, India	Pine Wood test panels	AM P35418 NMV J37426
Limnoria loricata Cookson	The Snares, New Zealand	Campbell Island*, New Zealand		NMV J37424 NMV J37425
Limnoria platycauda Menzies	West Indies. Puerto Rico. Belize. Cuba. Andaman Islands. Aldabra Atoll. Koniya, Japan. Satta Hip, Thailand. Admiralty Islands. Queensland, Australia. Karwar, India (NMV J37436, see Karande *et al.*, 1993).	Bombay*, India	Himalayan fir	NMV J37435
Limnoria quadripunctata Holthuis	Widespread cool temperate distribution, including New Zealand.	Cook Strait, New Zealand (see Chilton, 1916).	Gutta-percha cable	CM
Limnoria rugosissima Menzies	NSW, SA, Victoria, Tasmania, Australia. The Snares, New Zealand.	Ninepin Point*, Bicheno*, Tasmania. Gabo Island*, Victoria.	*Macrocystis* holdfasts* *Ecklonia* holdfasts	NMV J37434 NMV J37433 NMV J37417 NMV J37416
Limnoria unicornis Menzies	Caroline Islands. Andaman Islands. Palau. Huahine Island. San Salvador. Belize. Papua New Guinea. Northern Australia.	Port Douglas, Queensland.	Dead mangrove branch lying on mud amongst mangroves*	NMV J37454

Limnoria carptora sp. nov.

Figures 1, 2

Material examined. Holotype: Heard Island, Atlas Cove (53°00'S, 74°00'E), lower eulittoral, *Durvillaea antarctica* holdfasts, G. Edgar, 21 Feb 1988 (stn HI C1 6), NMV J17255 (male, 4.4 mm, 1.2 mm wide pleotelson, with 1 slide).

Paratypes: Type locality, NMV J17256 (female, 4.9 mm, with 1 slide), NMV J17257 (male, 4.2 mm, with 1 slide), NMV J17258 (2 males, 3.0, 4.8 mm, 2 non-ovig. females, 3.9, 4.1 mm, 6 ovig. females, 4.6, 4.8, 5.0, 5.1, 5.2, 5.2 mm).

Diagnosis. Pleonite 5 convex dorsomedially, without carinae. Pleotelson flattened, with weakly raised lateral crests, with 3 pair of flattened longitudinal carinae, anteromedial pair broad. Pleonite 5 0.5 times as long as pleotelson. Dorsal surface of pleotelson with scales fused, covered with solitary scale spikes, without pits. Posterior margin of pleotelson with dorsal row of scale spikes; margin fringed with 4 stout setae between which are short unsheathed setae and scale spikes.

Antenna 1 with 4 flagellar articles; second article with about 11 aesthetascs, third article narrow. Flagellum of antenna 2 with 4 articles. Mandibular palp with 3 articles. Mandibular incisors without rasp and file. Lacinia mobilis of right mandible unbranched, apically serrated. Epipod of maxilliped strap-like, 4 times as long as wide, reaching articulation of palp articles 1 and 2; epipod with simple true setae.

Secondary unguis of pereopod 1 bifid. Ventral comb seta present on merus of pereopod 7 and carpus of pereopods 6, 7 and sometimes 5. Uropod peduncle with short lateral spike setae, without prominent tubercles; endopod 0.65 times as long as peduncle.

Pleopod 2 with plumose setae up to 0.8 times length of exopod. Appendix masculina long, reaching beyond endopod tip, articulating proximal to midlength of endopod. Endopod of pleopod 5 anterior to exopod, oval, 0.8 times as long as endopod of pleopod 2; peduncle of pleopod 5 with simple seta laterally.

Additional characters. Body length up to 5.2 mm. Colour in alcohol light pink for fresh material, becoming pale yellow upon prolonged storage. Article 2 of mandibular palp with more than 1 simple seta.

Etymology. From the Latin for carver (of holdfasts).

Distribution. Heard Island, Southern Ocean. Lower eulittoral.

Substrates. Durvillaea antarctica holdfasts.

Remarks. This species is similar to *L. stephenseni* and *L. antarctica*. However, *L. stephenseni* lacks carinae (other than lateral crests) and puncta on the pleotelson, whereas *L. carptora* has six flattened but distinct longitudinal carinae. Also, the ventral branch of the secondary unguis of pereopod 1 on *L. stephenseni* is greatly reduced (see figures by Menzies, 1957; Wolff, 1990; Cookson, 1991), while for *L. carptora* this ventral branch is much larger, and usually of similar proportion to that found in *L. antarctica*. The smallest ventral branch seen in the material examined is illustrated (Fig. 2e). *L. carptora* has four large stout setae on the posterior margin of the pleotelson, whereas *L. stephenseni* has many positioned around the entire hind perimeter of the pleotelson. Furthermore, *L. stephenseni* grows up to 9.8 mm long, while the longest *L. carptora* specimen found so far is 5.2 mm. The appearance of the lacinia mobilis of the right mandible may not be a reliable difference between the two species. It is simple in *L. carptora*, while in *L. stephenseni* it may be simple (Menzies, 1957; Wolff, 1990) or bifid (Cookson, 1991).

L. carptora differs from *L. antarctica* mainly in the sculpturing found on pleonite 5 and the pleotelson. *L. carptora* lacks a transverse carina on pleonite 5. On the pleotelson of *L. carptora*, the dorsomedial carinae are flatter and broader than for *L. antarctica*, and anteromedial puncta absent. Both *L. carptora* and *L. stephenseni* differ from *L. antarctica* in that they have less defined and raised lateral crests on the pleotelson, the dorsal surface between the lateral crests on the pleotelson is flatter, and article 3 of antenna 1 is more narrow. *L. carptora* can reach 5.2 mm, while the largest *L. antarctica* specimen found is 4.7 mm (Cookson, 1991).

In the key to the species of *Limnoria* (Cookson, 1991), *L. carptora* should be inserted between *L. antarctica* and *L. stephenseni* at step 35:

— Pleotelson with carinae, pleonite 5 without carinae dorsomedially. Secondary unguis of pereopod 1 bifid. Posterior margin of pleotelson with 4 stout setae. Substrate algae ..... *L. carptora*

The distribution of *L. carptora* and *L. antarctica* may overlap, as *L. antarctica* has been found at Kerguelen Island (Menzies, 1957), which is near Heard Island. However, *L. stephenseni* has not been found in the waters off either island. Its distribution is the Auckland Islands, Macquarie

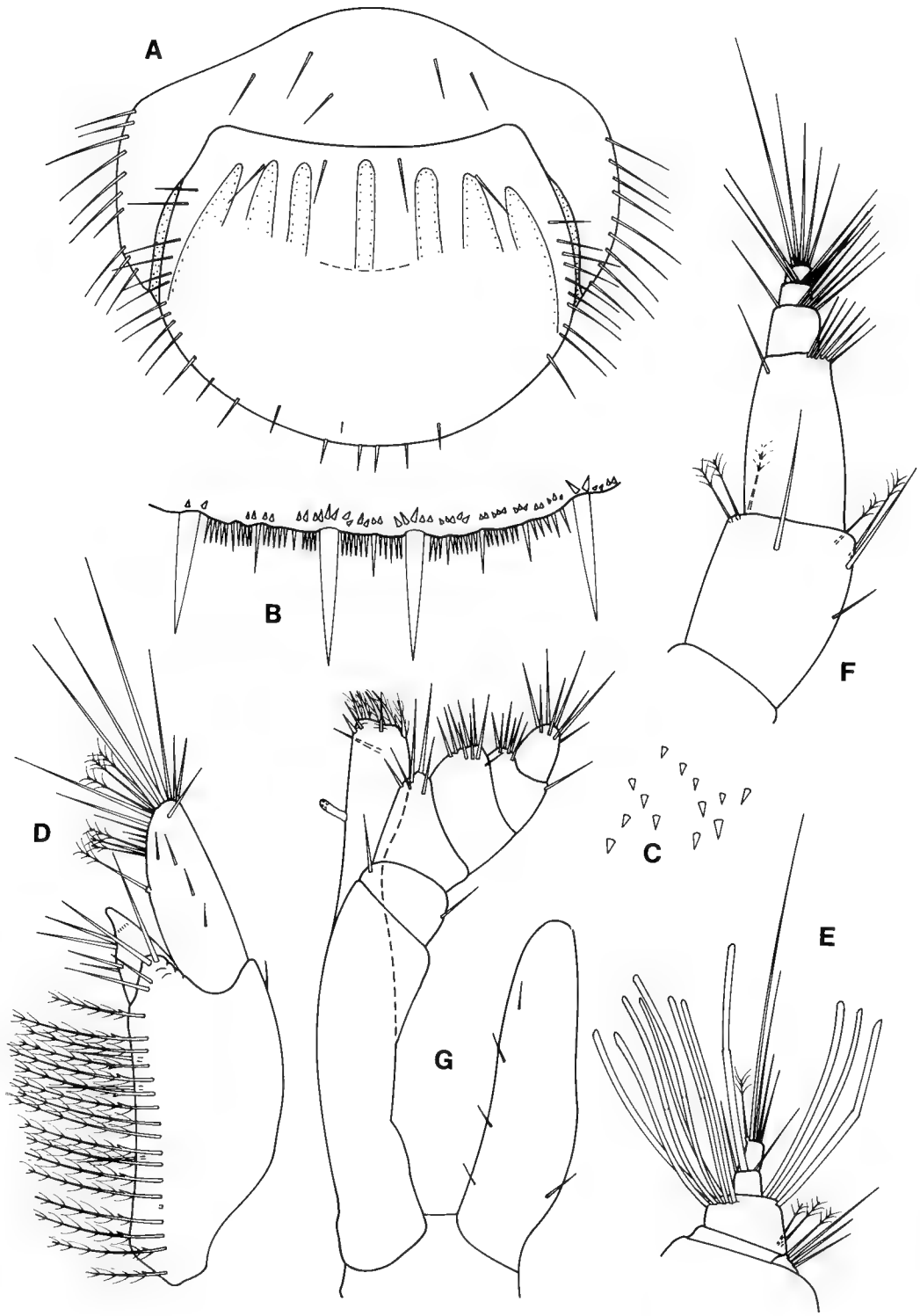


Figure 1. *Limnoria carptora* sp. nov. A-F, male, NMV J17255, holotype: A, pleonite 5 and pleotelson, dorsal view; B, posterior margin of pleotelson; C, dorsal surface of pleotelson; D, uropod, ventral view; E, flagellum of antenna 1; F, peduncle article 5 and flagellum of antenna 2. G, male, NMV J17257, paratype, maxilliped.

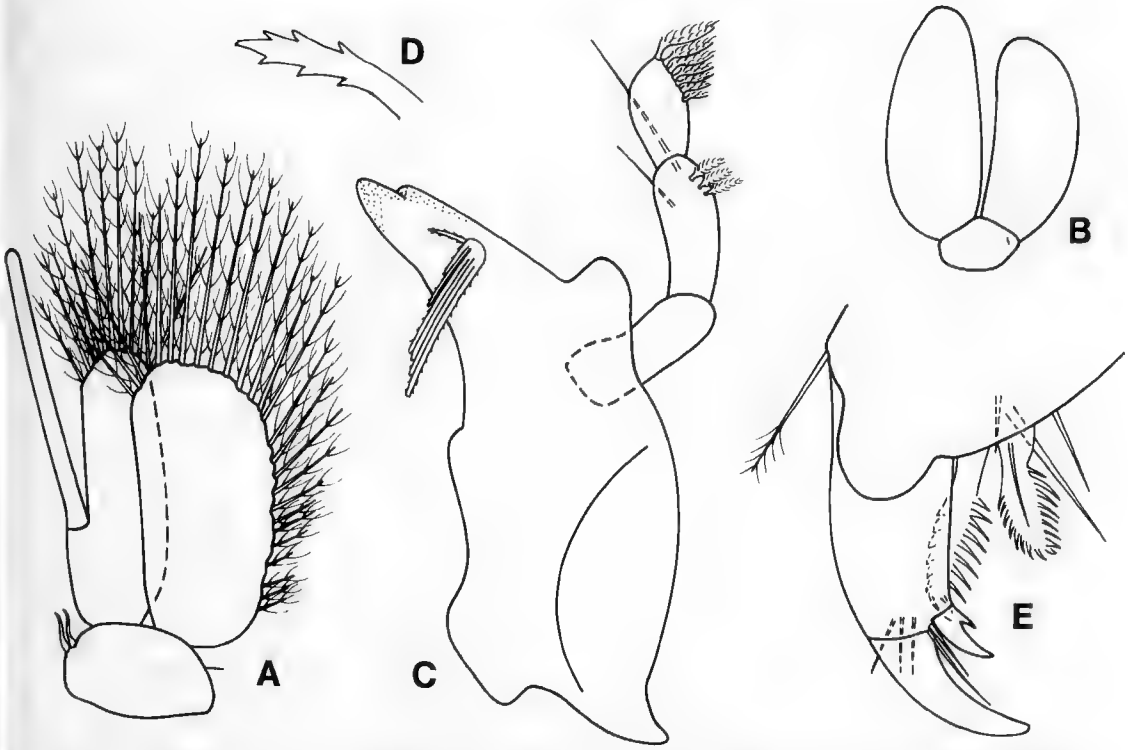


Figure 2. *Limnoria carptora* sp. nov. A-D, male, NMV J17255, holotype: A, pleopod 2; B, pleopod 5; C, right mandible; D, lacinia mobilis of right mandible. E, female, NMV J17256, paratype, distal articles of pereopod 1, lateral view.

Island and Marion Island (Wolff, 1990; Cookson, 1991). *L. stephenseni* and *L. carptora* have been collected from *Durvillaea* (Wolff, 1990; Cookson, 1991), and the former from *Macrocystis* as well (Hale, 1937). *L. antarctica* has been collected only from or near *Macrocystis* (Cookson, 1991).

Limnoria foveolata Menzies

Figure 3

Limnoria (Limnoria) foveolata Menzies, 1957: 175, fig 33.

Limnoria foveolata. — Cookson, 1991: 142. — Cookson, 1990: 2.

Material examined. Holotype, Kai Islands (6°5′S, 105°42′E), 52 m, Sigsbee trawl, sand, shells, Danish Expedition, 4 Aug 1922, ZMUC (non-ovig. female, with 2 slides).

Diagnosis (female). Pleonite 5 dorsomedially with 2 subparallel longitudinal weak carinae converging slightly posteriorly. Pleotelson with 1 pair of anteromedial puncta, with carinae posteriorly, with pair of weak anterolateral carinae. Pleonite 5 0.6 times as long as pleotelson. Dorsal surface of pleotelson with scales fused, covered with many solitary scale spikes. Lateral crests and posterior margin of pleotelson without dorsal row of tubercles; posterior margin fringed with 4 large stout setae between which are scale spikes and short-sheathed setae.

Antenna 1 with 4 flagellar articles; second article with 9 aesthetascs arising from 2 tufts. Flagellum of antenna 2 with 5 articles. Mandibular palp with 3 articles. Mandibular incisors with rasp and file. Lacinia mobilis of right mandible with several teeth at apex. Epipod of maxilliped subtriangular, about 3.3 times as long as wide, just short of palp articulation; epipod with true setae.

Secondary unguis of pereopod 1 bifid. Ventral comb seta present on merus of pereopod 7 and carpus of pereopods 2–7. Uropod peduncle without tubercles; endopod 0.9 times as long as peduncle.

Pleopod 2 with plumose setae up to 0.7 times length of exopod. Appendix masculina unknown. Endopod of pleopod 5 anterior to exopod, oval, 0.75 times as long as endopod of pleopod 2.

Additional characters. Body length 2.2 mm. Colour in alcohol pale yellow.

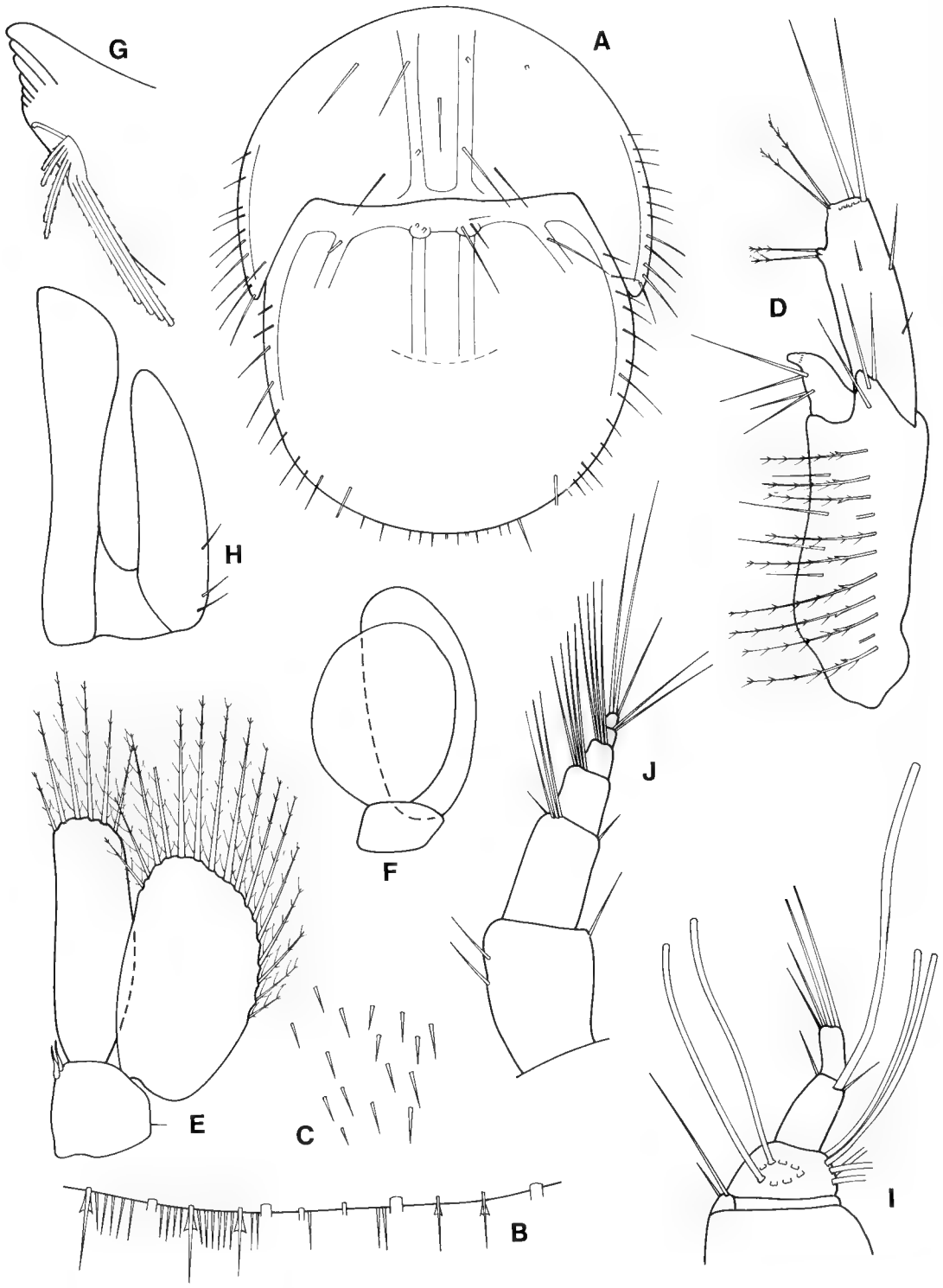


Figure 3. *Limnoria foveolata* Menzies. A-J, female, ZMUC, holotype: A, pleonite 5 and pleotelson, dorsal view; B, posterior margin of pleotelson, stout setae broken; C, dorsal surface of pleotelson; D, uropod, ventral view; E, pleopod 2; F, pleopod 5; G, distal portion of right mandible; H, epipod and basis of endopod of maxilliped; I, flagellum of antenna 1; J, peduncle article 5 and flagellum of antenna 2.

Distribution record. Known only from near the Kai Islands, Indonesia. 52 m depth.

Substrates. Unknown. The presence of rasp and file incisors on the mandibles suggests that this species is a wood or seagrass borer.

Remarks. Only the female holotype of *L. foveolata* is known, looking similar to female *L. indica* and *L. saseboensis* specimens. The differences that separate *L. foveolata* from these species remains unconvincing. Unfortunately, no male specimens of *L. foveolata* are known, which within this group of species is the sex that appears to offer most distinctive features. The pitted structure on the fifth pleonite and pleotelson must have been clearer when Menzies (1957) named this species for its foveolate appearance. However, when I examined the holotype the pitting could not be seen with reflected light at 80 times magnification, and was only slight at 800 times magnification using transmitted light. Perhaps some change in prominence of the pitting can occur upon storage. Such change was noted for the puncta of *Limnoria echidna* Cookson, although for this species the sculpturing became clearer upon storage (Cookson, 1991). I have not noticed dramatic loss in clarity of pitting in other species. At 80× magnification, an absence of pitting is characteristic of *L. indica*, while pitting is often clearly visible in the typical *L. saseboensis* specimen.

Menzies (1957) noted that *L. foveolata* differed from *L. saseboensis* in the lack of marginal tubercles on the pleotelson, and longer maxillipedal epipod. However, the latter character is variable, as some specimens of *L. saseboensis* have an epipod as long as that found in *L. foveolata*. The feature that distinguishes *L. foveolata* most easily from *L. saseboensis* and *L. indica*, is the lack of tubercles on the lateral crests of the pleotelson. *L. foveolata* also lacks tubercles on the posterior margin of the pleotelson, but this condition can be found in some specimens of both *L. saseboensis* and *L. indica* also. *L. foveolata* has a weak pair of anterolateral carinae on the pleotelson, which is normally absent in *L. indica* but present in *L. saseboensis*. However, the difference again is not impressive.

L. foveolata may become synonymised with either *L. saseboensis* or *L. indica* on the basis of future studies. The type locality lies within the distribution range of *L. indica*, not *L. saseboensis*.

Limnoria saseboensis Menzies

Figures 4, 5

Limnoria (Limnoria) saseboensis Menzies, 1957: 141, 144, fig 18. — Menzies, 1959: 22.

Limnoria saseboensis. — Kühne, 1976: 546–547, fig 5.-Jones et al., 1976: 134. — Kensley and Schotte, 1989: 198, fig 87D. — Cookson, 1991: 143 155. — Cookson, 1990: 4. — Cookson et al., 1991: 45.

Limnoria indica. — Cookson, 1987: 85–89, figs 1–8 (Goat Island material). — Cookson and Barnacle, 1987a: 143. — Cookson and Barnacle, 1987b: 287–293 (Goat Island material).

Material examined. Paratypes, Japan, Sasebo, W.F. Clapp, 22 Aug 1949 and 24 Jan 1950, USNM 91749 (5 males, 1 female; non-ovig female, 3.5 mm, with 1 slide: specimens in poor condition).

Japan, Sasebo (33°7′26″N, 129°44′16″E), 10 m, wood test panel submerged 6 Jul 1966–7 Dec 1966, BAM (5 females 2.5–3.6 mm, male 2.9 mm), Koniya, 1968, BAM (male 2.9 mm, female 3.0 mm).

NSW, Sydney, pine bait blocks, R.D. Turner and J.V. Marshall: Watsons Bay, 26 Nov 1971, AM P35378 (5), Watsons Bay, 4 Aug 1971, AM P37046, Cammeray, 10 Feb 1972, AM P35384 (1 male, 2 females up to 3.9 mm), Cabarita, 30 Jun 1971, AM P38269 (1), AM P37044 (2), Goat Island, 27 May 1970, AM P35389 (33), Goat Island, 1971, AM P35390 (24), Goat Island, 4 Feb 1972, AM P37042 (3), Goat Island, 0.5–1 m, *E. pilularis* timber, J. Beesley, 15 Sep 1975, NMV J37438 (2), various test timbers, L.J. Cookson and J.E. Barnacle, 1 Mar 1985, NMV J15258 (8), NMV J15263 (21), NMV J15257 (20), NMV J15259 (16), NMV J15260 (male, 3.1 mm, with 1 slide), NMV J15268 (3), NMV J15274 (20), NMV J15276 (9), L.J. Cookson, 18 Mar 1983, NMV J15264 (11) NMV J15265 (20) NMV J15266 (14). Coffs Harbour, Police Jetty Marina, *P. radiata* block placed 14 Jan 1988, R. Livesay and L.J. Cookson, 4 Jul 1988, NMV J15251 (5).

WA, Geraldton, wharf piles, R.D. Turner and J.V. Marshall, 7 Nov 1970, AM P37045 (2), CCA-treated jarrah piles pulled up on beach for several months, J.E. Barnacle, 1 May 1989, NMV J37443 (34), NMV J37442 (male, 3.7 mm), NMV J37444 (male 3.3 mm, with 1 side), NMV J37445 (male, 3.0 mm, with 1 slide), NMV J37446 (female, 3.4 mm, with 1 slide), NMV J37447 (intersex, 3.7 mm, with 1 slide), Geraldton, Fishing Boat Harbour, 1 m below low tide, jarrah piles, J. Boys, 5 May 1989, NMV J37440 (17), 28 Sep 1989, NMV J37439 (70), Roebourne, pine bait block, R. Howlett, Nov 1960, NMV J14934 (male), Point Samson, jetty, CCA-treated eucalypt pile, J.E. Barnacle, 15 Sep 1985, NMV J14962 (3) untreated eucalypt, NMV J14961 (3, with 1 slide), jarrah piles washed onto beach, J.E. Barnacle, 23 Apr 1989, NMV J37441 (8).

Qld, Wreck Reef, off Gladstone, (22°11′S, 155°15′E), 12 m, in *Casuarina* from 'Cato' shipwreck, W. Delaney, 18 May 1988, NMV J15210 (4 pleotelsons). Urangan Boat Harbour, Maryborough, low tide, turpentine pile, J.E. Barnacle, 10 Feb 1986, NMV J14995 (3), NMV J14996 (13).

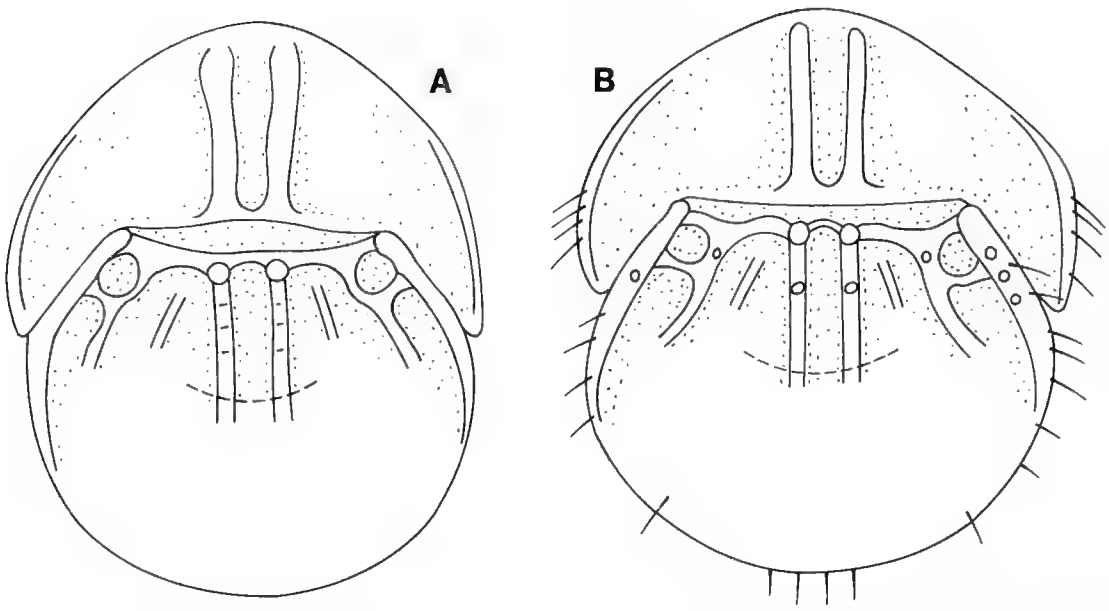


Figure 4. *Limnoria saseboensis* Menzies. A, female from Sasebo, USNM 91749, paratype, pleonite 5 and pleotelson, dorsal view. B, male from Geraldton, NMV J37442, pleonite 5 and pleotelson.

Diagnosis (male). Pleonite 5 dorsomedially with 2 subparallel longitudinal carinae which may converge slightly posteriorly. Pleotelson with 1 or 2 pairs of anteromedial puncta, if two pairs, then one is directly behind other at a distance equal to or longer than distance between anterior puncta, with carinae behind posterior pair of puncta, with an anterolateral pair of puncta or long setae each anterior to short lateral carina. Pleonite 5 0.5 times as long as pleotelson. Dorsal surface of pleotelson with scales fused, covered with many solitary scale spikes, sometimes strongly pitted anteriorly. Dorsal row of tubercles extend from lateral crests to posterior margin of pleotelson; posterior margin fringed with 4 large stout setae between which are scale spikes and short-sheathed setae.

Antenna 1 with 4 flagellar articles; second article with about 15 aesthetascs arising from 2 tufts. Flagellum of antenna 2 with 5 articles. Mandibular palp with 3 articles. Mandibular incisors with rasp and file. Lacinia mobilis of right mandible straight, apex with several teeth. Epipod of maxilliped subtriangular, about 3 times as long as wide, not reaching palp articulation; epipod with true setae.

Secondary unguis of pereopod 1 bifid. Ventral comb seta present on merus of pereopod 7 and carpus of pereopods 2–7. Uropod peduncle laterally with short simple setae; with small tubercles between plumose setae; endopod 0.85 times as long as peduncle.

Pleopod 2 with plumose setae up to 0.5 times length of exopod. Appendix masculina reaching apex of endopod of pleopod 2, articulating just proximal to midlength of endopod. Endopod of pleopod 5 anterior to exopod, broadly oval to circular, 0.7 times as long as endopod of pleopod 2; peduncle of pleopod 5 with simple seta laterally.

Additional characters. With sexual dimorphism of pleotelson sculpturing; female with pair of anteromedial puncta followed posteriorly by long carinae, pleotelson without other puncta. Body length up to 4.1 mm. Colour in alcohol pale yellow.

Distribution. Sasebo, Japan; Florida (Menzies, 1957); Japan (Kühne, 1976). Eastern Australia from Sydney to Maryborough. Western Australia from Geraldton to Point Samson near Roebourne (current study). Depth range 0–12 m.

Substrates. From a causeway, presumably in wood (Menzies, 1957). *P. radiata* and various eucalypt timbers which were either untreated or preservative treated, *Syncarpia glomulifera* (turpentine), *Casuarina* (current study).

Remarks. For some time I wrongly identified certain populations of this species as the very similar *L. indica* (Cookson, 1987, Cookson and Barnacle, 1987b). However, all references to *L. indica* and *L. saseboensis* in Cookson (1991) are correct.

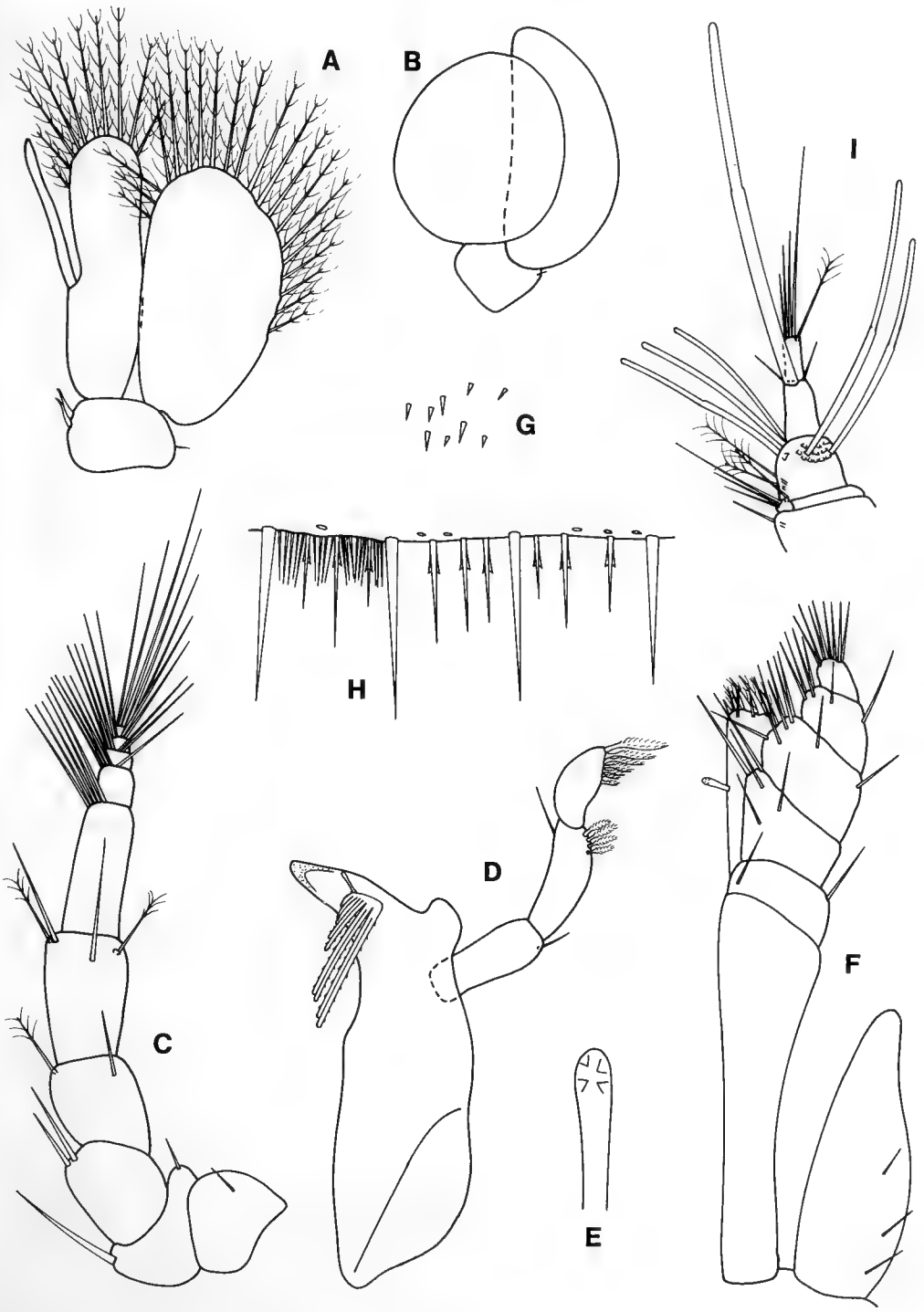


Figure 5. *Limnoria saseboensis* Menzies. A-B, male from Sasebo, USNM 91749, paratype: A, pleopod 2, *in situ*; B, pleopod 5, *in situ*. C-F, female from Sasebo, USNM 91749, paratype: C, antenna 2; D, right mandible; E, lacinia mobilis of right mandible; F, maxilliped. G-H, male from Geraldton, NMV J37442: G, dorsal surface of pleotelson; H, posterior margin of pleotelson. I, male from Point Samson, NMV J14961, flagellum of antenna 1.

Often, there is no difference between *L. saseboensis* and *L. indica* in shape or length of the maxillipedal epipod (Kühne, 1976; current study), although this character was used by Menzies (1957). Another character that cannot be relied upon is the slight posterior convergence of the longitudinal parallel carinae found dorsally on pleonite 5 (Kühne, 1976; current study figs 4a and 4b). The degree of pitting found on pleonite 5 and the pleotelson, as exemplified in Fig. 18D given by Menzies (1957), also varies. This pitting was well developed in the paratypes of *L. saseboensis*. However, many specimens from Australia lack the large carinated pits found on the typical *L. saseboensis* specimen, so resemble *L. indica* where carinated pits are not noticeable at low magnification (80x). These pits are noticeable on *L. indica* at higher magnification (Kensley and Schotte, 1987). Menzies (1957) did not give the number of puncta found on the two parallel carinae on the dorsal surface of the pleotelson: "carinae tuberculate anteriorly and less so posteriorly". The male however has either two or four puncta, and the female two puncta. Few specimens are without puncta. Also, some male specimens from Australia and Japan have an anterolateral pair of puncta on the pleotelson, similar to that sometimes found on *L. indica* males (Kühne, 1976; current study). These were not to be found in the type material, although for some, a large seta at the equivalent position was noted. Therefore, the sexual dimorphism found in *L. indica* can also occur in some specimens of *L. saseboensis*. To further complicate the matter, the lacinia mobilis on the right mandible of *L. saseboensis* was said to have two medially curved teeth at the apex (Menzies, 1957). However, the number of teeth found can be greater than this (Fig. 5e; Cookson, 1987, Figs. 6–8), and so is similar to the lacinia mobilis found on *L. indica*.

The population of *L. saseboensis* on the west coast of Australia often differs from the population on the east coast. While some males from both coasts have the pair of anterolateral puncta on the pleotelson, most males from eastern Australia have two pairs of anteromedial puncta, and most males in Geraldton have just one pair of anteromedial puncta. However, this is not a constant difference that could be used to separate the two populations as species. One male in the Geraldton material (Fig. 4b) had all six puncta. Also, the single male from Roebourne (NMV J14934) had six prominent puncta (Roebourne is an inland location, so the point of collection was probably Point Samson). The six puncta (four anteromedial, two anterolateral) often found in male *L. saseboensis* from eastern Australia is clearly shown in the Fig. 2 provided by Cookson (1987). In this regard, *L. saseboensis* males from eastern Australia can look very similar to *L. indica* males.

The most reliable difference to be found between male *L. indica* and male *L. saseboensis* specimens is that *L. indica* always has two pair of anteromedial puncta, while *L. saseboensis* may be without puncta or have just one pair. If *L. saseboensis* has two pairs of puncta, then the two puncta born on the same longitudinal carina will be further apart or equal in distance to each other, than they are with their paired partner. In other words, the four puncta are longitudinally more separated than laterally separated. For *L. indica*, the two pair of puncta are always wider apart than longer apart. Sometimes, the posterior pair are especially wide, as was drawn in the original description by Becker and Kampf (1958), and shown in SEM photographs by Kensley and Schotte (1987). Also, male *L. saseboensis* have carinae posterior to the hind pair of anteromedial puncta, while *L. indica* males do not. The key given by Cookson (1991) correctly separates male *L. saseboensis* and *L. indica*, based upon this character of carina presence or absence behind the pleotelson puncta.

Other characters if present and clear, can assist in identification. Lateral carinae (those medial of lateral crests) are usually present in both sexes of *L. saseboensis*. Such lateral carinae are absent, or very slightly developed in *L. indica*. The surface pitting of pleonite 5 and the pleotelson can also be useful if developed. In Australia, pitting was rare in the west coast specimens, but more common in those from eastern Australia, where the level of pitting was also variable between individuals from the same population. Another related character, found in most but not all specimens of *L. saseboensis*, was the pair of large circular carinae adjoining the anterior end of the lateral crests. This circular carina is constructed from several portions: the anterior portion of the lateral crest, the anterolateral carina and puncta, and two bridging carinae (Figs. 4a, b). *L. indica* has the lateral crest portion, and often the anterolateral puncta, but the remaining components are essentially absent. The endopod of pleopod 5, another variable character, tends to be rounder in *L. saseboensis* than *L. indica*.

It can at times be difficult or impossible, based upon known characters, to separate female *L. indica* and *L. saseboensis*. This is especially true

if pitting and lateral carinae on the pleotelson are absent or ill defined. One further notable difference is that *L. saseboensis* is often larger. The longest *L. indica* specimen known is 3.3 mm, whereas the longest *L. saseboensis* specimen is 4.1 mm.

In Australia, *L. saseboensis* has a warm temperate distribution, while *L. indica* is tropical and subtropical in range. Overlap of the two species has not been observed. In eastern Australia *L. saseboensis* extends from Sydney to as far north as Maryborough, while *L. indica* can be found from Gladstone to Papua New Guinea. In Western Australia *L. indica* has not been found. This absence might explain why *L. saseboensis* can be found further north than on the east coast, from Geraldton to Point Samson. *L. saseboensis* and *L. indica* appear to have similar substrate preferences, in that, within their distribution range on the east coast, they are the limnoriid species most likely to be found on untreated turpentine timbers (Cookson, 1987; further unpublished data).

Limnoria simulata Menzies

Figures 6, 7

Limnoria (Limnoria) simulata Menzies, 1957: 144, fig 19. — Menzies, 1959: 20.

Limnoria simulata. — Carvacho, 1977: 17–18, figs 5 g-i (possibly). — Kensley and Schotte, 1987: 222. — Müller, 1988: 397–403, figs 1–23 (Colombian material). — Kensley and Schotte, 1989: 198. — Cookson, 1991: 143, 192–193. — Cookson, 1990: 6.

Not *Limnoria simulata.* — Müller, 1988: 398 (Indian material). — McKoy-Hill, 1964: 46.

Material examined. Holotype, West Indies, Virgin Islands, 16 Feb 1914, ZMUC (male, 3.0 mm, with 1 slide). Paratype, type locality, ZMUC (male).

USA, Florida, north of North Key, Tarpon Springs, 1 m, found on *Thalassia* on mud flat, water temperature 13.3°C , salinity 23.6, Phillips, Greeley, Mann, 19 Dec 1958, USNM 103005 (leaf with burrow, 2 females missing cephalon, male 2.5 mm, with 1 slide, ident. by R.J. Menzies).

Colombia, Bahia de Nenguangue, near Santa Marta, 0.5 m, *Thalassia*, H.-G. Müller, 17 Jan 1986, ZMUC (12 males, 2 females), 0–1 m, 5 Aug 1985, ZMUC (6 males, 4 females, 1 juvenile)

Diagnosis (male). Pleonite 5 dorsomedially with a faint longitudinal sulcus. Pleotelson with 1 or 2 pairs of anteromedial puncta, if two pairs, then puncta wider apart than longitudinally apart, without carinae; with an anterolateral pair of puncta or setae. Pleonite 5 0.5–0.6 times as long as pleotelson. Dorsal surface of pleotelson with scales partially fused, bordered posteriorly with several short scale spikes, sometimes slightly pitted anteriorly. Dorsal row of tubercles on lateral crests of pleotelson, some bearing several short scale spikes; posterior margin fringed with 4–6 large stout setae between which are scale spikes and short-sheathed setae, lacking posterior row of tubercles, sometimes with irregular row of short scale spikes in groups of 2–5.

Antenna 1 with 4 flagellar articles; second article with about 6–11 aesthetascs. Flagellum of antenna 2 with 5, sometimes 4 articles. Mandibular palp with 3 articles. Mandibular incisors with rasp and file, rasp confined to distal half of incisor. Lacinia mobilis of right mandible straight, apex with several long or short teeth. Epipod of maxilliped subtriangular, about 3 times as long as wide, reaching or just short of palp articulation; epipod with true setae.

Secondary unguis of pereopod 1 bifid. Ventral comb seta present or absent on merus of pereopod 7, present on carpus of pereopods 2–7. Uropod peduncle laterally with or without small tubercles between plumose setae; endopod 0.75–1 times as long as peduncle.

Pleopod 2 with plumose setae up to same length of exopod. Appendix masculina reaching beyond apex of endopod of pleopod 2, articulating near midlength of endopod. Endopod of pleopod 5 anterior to exopod, oval, 0.8 times as long as endopod of pleopod 2.

Additional characters. Sculpturing on pleotelson often sexually dimorphic, as female has just one anteromedial pair of puncta, followed posteriorly by weak parallel carinae; female without anterolateral puncta. Body length up to 3.2 mm (Müller, 1988). Colour in alcohol pale yellow.

Distribution. Virgin Islands, West Indies (Menzies, 1957); Caribbean Sea of north Colombia (Müller, 1988); Tarpon Springs, Florida (current study). Depth: 0–4 m (Müller, 1988).

Substrates. Washed from the seagrass *Thalassia testudinum* (Müller, 1988); leaves of the seagrass *Thalassia* (current study).

Remarks. Some variations in the specimens were noted. The ventral comb seta on the merus of pereopod 7 was present in the specimens from Tarpon Springs, and in some specimens from Colombia, but absent in both types. The flagellum of antenna 2 was drawn to have four articles by Menzies (1957). However, this was difficult to confirm from the slide that he had prepared, as the tip was hidden by setae and debris. The male paratype examined *in situ* had five articles.

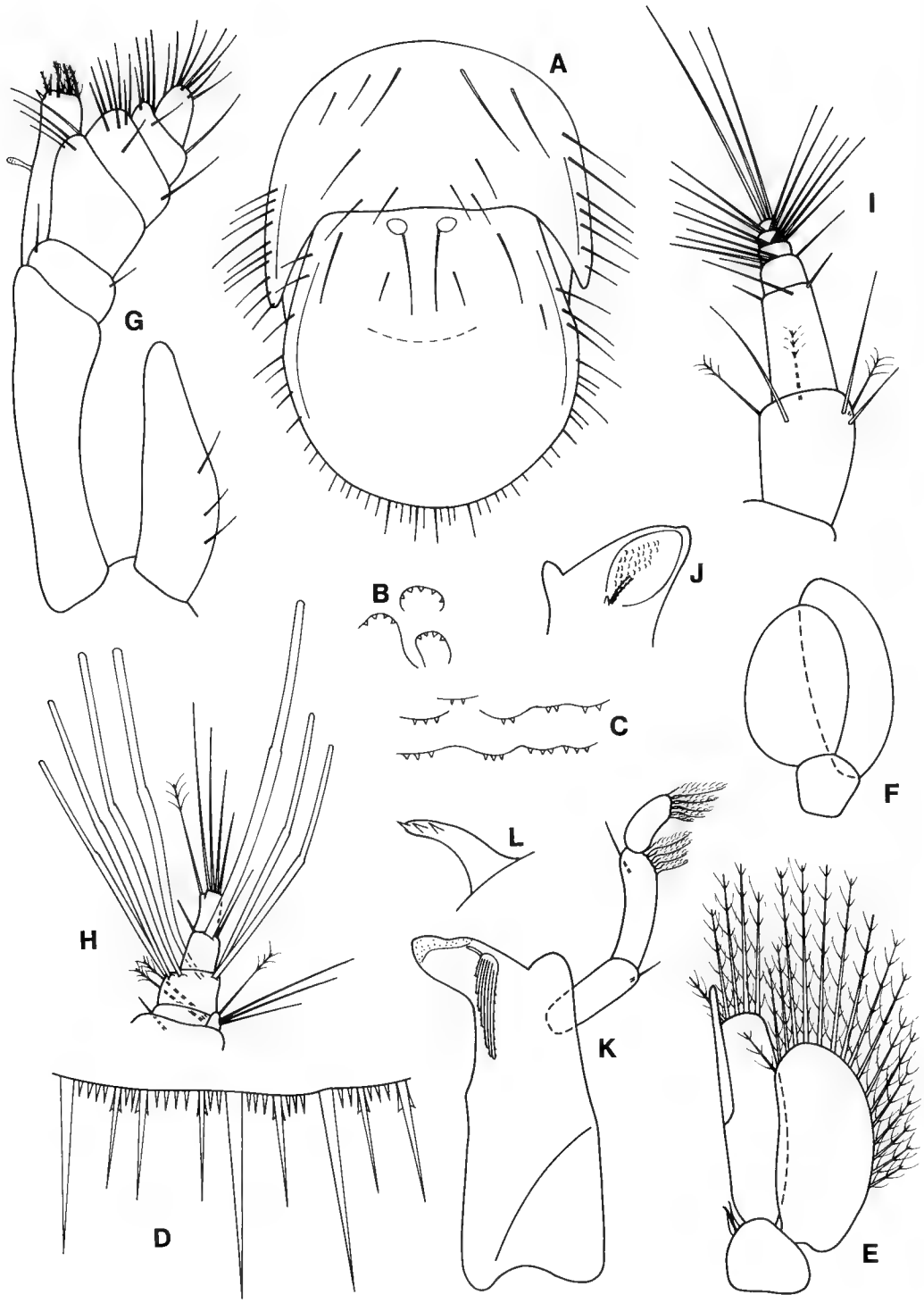


Figure 6. *Limnoria simulata* Menzies. A-L, male, USNM 103005: A, pleonite 5 and pleotelson, dorsal view: B, anterodorsal surface of pleotelson; C, posterodorsal surface of pleotelson; D, posterior margin of pleotelson; E, pleopod 2; F, pleopod 5; G, maxilliped; H, flagellum of antenna 1; I, peduncle article 5 and flagellum of antenna 2; J, incisor of left mandible; K, right mandible; L, lacinia mobilis of right mandible.

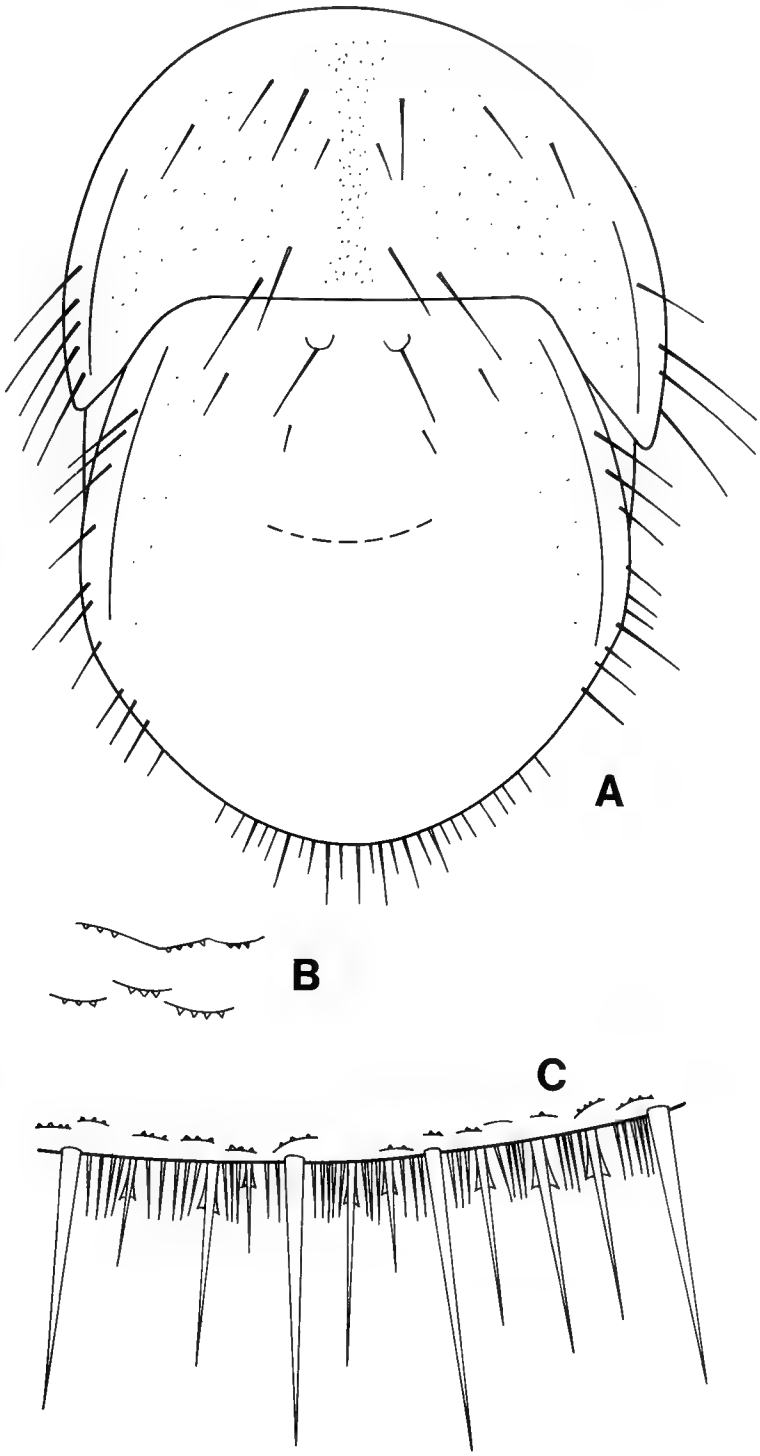


Figure 7. *Limnoria simulata* Menzies. A-C, male, ZMUC, paratype: A, pleonite 5 and pleotelson, dorsal view; B, posterodorsal surface of pleotelson; C, posterior margin of pleotelson.

although the last was very small. Müller (1988) also noted five articles in his specimens. The posterior margin of the pleotelson bore six stout setae in both type specimens, and in both females from Tarpon Springs, whereas the male from Tarpon Springs had four stout setae.

L. simulata, *L. indica*, *L. saseboensis*, and *L. hicksi* Schotte, are all known to share, for some specimens at least, the pattern on the pleotelson of two anteromedial and one anterolateral pairs of puncta.

L. simulata is most similar to *L. indica*, and Müller (1988) synonymised *L. indica* with *L. simulata*. However, I propose that the two should remain separate species. *L. simulata* has carinae on pleonite 5 much less defined than for *L. indica*. In the specimens of *L. simulata* examined, there was a faint longitudinal sulcus on pleonite 5. What might have been carinae on either side of the sulcus, were so gradually merged with the general surface, that I would prefer not to call them carinae. Sulcus is the term used by Menzies (1957). *L. simulata* generally has longer and more numerous setae dorsally on pleonite 5 than *L. indica*. The anteromedial puncta on the pleotelson of *L. simulata* are much less defined than for *L. indica*. Often there is just one anteromedial pair of puncta on the pleotelson of *L. simulata*, not two as always occurs for *L. indica*. *L. simulata* lacks tubercles on the posterior margin of the pleotelson, while the majority of *L. indica* have these. Both species have tubercles on the lateral crests, though often less developed in *L. simulata* than *L. indica*. *L. simulata* often has six stout setae on the posterior margin of the pleotelson, while *L. indica* has just four. Both the plumose setae on pleopod 2, and the appendix masculina, are longer in *L. simulata* than *L. indica*. The rasp of the right mandible is much reduced compared to that found in *L. indica*.

Many of these differences are differences of gradation. However, the dorsal structure of the surface of the pleotelson is quite different. *L. indica* has large solitary scale spikes, whereas *L. simulata* has short teeth-like scale spikes arranged in rows as groups of mostly three to five. For *L. simulata*, some of these scale spikes can also be seen on the tubercles on the lateral crests. Another important ecological difference is that *L. simulata* is a seagrass borer, while *L. indica* has been found only in wood.

Acknowledgements

Material loaned for inclusion in this study was generously provided by Dr Gary Poore (NMV), Penny Berents and Dr Jim Lowry (AM), Dr Torben Wolff and Dr Niel Bruce (ZMUC), Dr H. Hertel (BAM), Dr Ian Mannering (CM), Marilyn Schotte and Dr Brian Kensley (USNM), B.S. Swami, Naval Chemical & Metallurgical Laboratory, and Leela Devi. I would like to thank both John Barnacle for the important collections he made from various localities around Australia, and Jan Cookson for drafting the majority of figures.

References

Becker, G. and Kampf, W.-D., 1958. Funde der holzzerstörenden Isopodengattung *Limnoria* an der Festlandküste Indiens und Neubeschreibung von *Limnoria indica*. *Zeitschrift für Angewandte Zoologie* 45: 1–9.

Brearley, A. and Walker, D.I., 1993. Isopod borers in seagrass species from south-western Australia. Pp. 415–428 in: Wells, F.E., Walker, D.I., Kirkman, H., and Lethbridge, R. (eds), *Proceedings of the Fifth International Marine Biological Workshop: The Marine Flora and Fauna of Rottnest Island, Western Australia*. Western Australian Museum: Perth. 2 vols.

Carvacho, A., 1977. Isopodes de la mangrove de la Guadeloupe, Antilles Françaises. *Studies on the Fauna of Curaçao and other Caribbean Islands* 54 (174): 1–24.

Chilton, C., 1916. The gribble (*Limnoria lignorum*, Rathke) attacking a submarine cable in New Zealand. *Annals and Magazine of Natural History* 18: 208.

Cookson, L.J., 1987. The occurrence of *Limnoria indica* Becker & Kampf (Isopoda) on the eastern coast of Australia. *Crustaceana* 52: 85–89.

Cookson, L.J., 1990. Annotated check-list of the Limnoriidae. *The International Research Group on Wood Preservation*. Document No. IRG/WP/4160.

Cookson, L.J., 1991. Australasian species of the Limnoriidae (Crustacea: Isopoda). *Memoirs of the Museum of Victoria* 52: 137–262.

Cookson, L.J. and Barnacle, J.E., 1987a. The performance in Australia after ten years in the sea of single and double preservative treated timber specimens. *Material und Organismen* 22: 139–160.

Cookson, L.J. and Barnacle, J.E., 1987b. Predominance of the marine borer *Limnoria indica* Becker & Kampf on turpentine timber. *International Biodeterioration* 23: 287–293.

Cookson, L.J., Barnacle, J.E. and Beesley, J., 1991. Australian marine test of pesticides impregnated as supplementary treatments for creosote- or CCA-treated wood. *Wood Protection* 1: 43–48.

Cookson, L.J. and Poore, G.C.B., 1994. New species of *Lynseia* and transfer of the genus to Limnoriidae (Crustacea: Isopoda). *Memoirs of the Museum of Victoria* 54: 179–189.

Hale, H.M., 1937. Isopoda and Tanaidacea. *Australasian Antarctic Expedition. 1911–14, Scientific Reports. Series C, Zoology and Botany* 2: 1–45.

Jones, E.B.G., Turner, R.D., Furtado, S.E.J. and Kühne, H., 1976. Marine biodeteriogenic organisms I. Lignicolous fungi and bacteria and the wood boring Mollusca and Crustacea. *International Biodeterioration Bulletin* 12: 120–134.

Karande, A.A., Swami, B.S. and Udhayakumar, M., 1993. Timber deterioration by *Limnoria platycauda* Menzies (Isopoda) along Karwar coast of India. *Raffles Bulletin of Zoology* 41: 75–82.

Kensley, B. and Schotte, M., 1987. New records of isopod crustacea from the Caribbean, the Florida Keys, and the Bahamas. *Proceedings of the Biological Society of Washington* 100: 216–247.

Kensley, B. and Schotte, M., 1989. *Guide to the marine isopod crustaceans of the Caribbean.* Smithsonian Institution Press: Washington, D.C.

Kühne, H., 1976. Zur geographischen Verbreitung holzzerstörender Crustaceen und Systematik der Untergattung *Limnoria* s. str. Menzies. *Material und Organismen Supplement* 3: 543–553.

McCoy-Hill, M., 1964. The marine borer problem-3. *Wood* 29: 43–46.

Menzies, R.J., 1957. The marine borer family Limnoriidae (Crustacea, Isopoda). *Bulletin of Marine Science of the Gulf and Caribbean* 7: 101–200.

Menzies, R.J., 1959. The identification and distribution of the species Limnoria. Pp. 10–33 in: Ray, D.L. (ed.), *Marine boring and fouling organisms.* University of Washington Press: Seattle.

Müller, H.-G., 1988. Redescription, synonymy, and ecology of *Limnoria simulata* Menzies 1957 from the Caribbean Sea of N-Colombia. *Senckenbergiana Biologica* 69: 397–403.

Wolff, T., 1990. The appendages of *Limnoria stephenseni* Menzies (Isopoda: Flabellifera). *Bijdragen tot de Dierkunde* 60: 311–318.

Memoirs of the Museum of Victoria 56(1):145–234 (1997)

A NEW GENUS OF MARINE ISOPOD (CRUSTACEA: FLABELLIFERA: SPHAEROMATIDAE) FROM AUSTRALIA AND THE INDO-PACIFIC REGION

NIEL L. BRUCE

Zoologisk Museum, University of Copenhagen, Universitetsparken 15, DK 2100, Copenhagen , Denmark.

Abstract

Bruce, N.L., 1997. A new genus of marine isopod (Crustacea: Flabellifera: Sphaeromatidae) from Australia and the Indo-Pacific Ocean. *Memoirs of the Museum of Victoria* 56: 145–234.

Oxinasphaera gen. nov. is established for a group of sphaeromatid species previously placed in the genus *Cymodoce* Leach, 1818. Apomorphic characters allowing easy recognition of genus are (in the male), hardened prominent spikes on the anterior margin of the antennule peduncle, on the epistome (or with a transverse blade), and on the posterior of the pereonites, maxilliped palp articles 3 and 4 with greatly elongated medial margin, article 5 also greatly elongated, all with an obliquely truncate densely setose apex, uropod endopod with deeply bifid toothed apex and uropod endopod with hardened prominent spikes at ventrodistal apex. Additionally, the pleon and pleotelson are dorsally denticulate, the pleotelson usually with a divided posterior margin but without a distinct exit channel. Species transferred from *Cymodoce* are *C. tuberculosa* Stebbing, 1873, C. *tripartita* Richardson, 1910, *C. multidens* Richardson, 1910, C. *bispinosa* Baker, 1910, and C. *australis* Baker, 1929. The following new species are described: *Oxinasphaera bisubula* sp. nov. (type species), *O. aylostera* sp. nov., *O. copiapoa* sp. nov., *O. corypantha* sp. nov., *O. denmoza* sp. nov., *O. epostoa* sp. nov., *O. frailea* sp. nov., *O. islaya* sp. nov., *O. kensleyi* sp. nov., *O. lobivia* sp. nov., *O. lowryi* sp. nov., *O. matucana* sp. nov., *O. obregonia* sp. nov., *O. parodia* sp. nov., *O. poorei* sp. nov., *O. rebutia* sp. nov., *O. thetisae* sp. nov., O. *tual* sp. nov.

The genus is recorded from South Africa, the Western Indian Ocean, around the Australian coastline, New Caledonia, Indonesia, Papua New Guinea and the Philippines. All species but one are recorded from shallow water at depths from the intertidal generally to within 100 m; one species is recorded from a depth of 400 m. Many specimens and most species are recorded as having been collected from sponges. A phylogenetic analysis of the species is undertaken and brief comments given on the relationships within the genus and on the biogeography of the genus. A key to the named species is given.

Contents

Introduction

The genus *Cymodoce* Leach, 1814 is large, containing a wide array of morphologically diverse species. The genus and the European species, including the type species, were reviewed by Dumay (1972a, b, c, d). The most detailed recent description to the genus is that of Harrison and Holdich (1984), who gave an account of the Australian species, together with extensive comments on the confused taxonomic state of the genus. Harrison and Holdich (1984, appendix 2) also listed the known species and gave further discussion on the status of the numerous misplaced species that, according to their perception, did not appear to belong to the genus.

Among the species that Harrison and Holdich (1984) discussed was a group of distinctive species related to *Cymodoce tuberculosa* Stebbing, 1873. Harrison and Holdich (1984), without giving any reasons or descriptive comments relating to morphological criteria, suggested that these species would "require the formation of a new genus to house them." This group of often common and very distinctive Indo-West Pacific isopods, here defined as a new genus, is easily recognizable by the males having the antennule peduncle article 1 with comb-like arrangement of white prominent downwardly directed spikes, similar prominent spikes on the epistome, and prominent spikes arranged in transverse bands across the dorsum of pereonites 2, 3, or 4 -7. The generally very nodular and setose body surfaces and the deeply bifid short uropod exopod and cylindrical spiked uropod endopod also serve to distinguish the genus. Although the new genus can be clearly defined with several unambiguous autapomorphies, the remaining species of *Cymodoce* still present a no less confused assemblage, in reality containing species that should be placed in several genera. The arguments and discussion concerning *Cymodoce* have been presented by Harrison and Holdich (1984) and are not repeated here.

The new genus is here defined, and the species described together with an identification key. The genus is can be clearly delimited by several autapomorphies, and as monophyly can therefore reasonably be assumed, a cladistic analysis was performed to examine the relationships between the species, to more objectivley discriminate the species groups, and to assess character distribution and apparently homoplasious characters.

Material and methods

Material for study was obtained from Australian state museums, by far the largest proportion being that held by the Museum of Victoria, Melbourne and the Australian Museum, Sydney. Additional material was borrowed from the other institutions listed, but the only unreported material obtained other than from Australia institutions was that which had been collected by Th. Mortensen early this century and held at the Zoologisk Museum, University of Copenhagen.

Methodology follows that of Bruce (1994b), except that dissected appendages were drawn using Nomarski illumination, and the scanning electron microscope used was a Jeol JSM 840. The cladistic analysis was performed using the computer programme PAUP 3.1.1. The data set was run using the heuristic search option (settings tree-bisection-reconnection [TRR] and MULPARS option). Trees and characters were examined using the computer package

MacClade 3.03, and the cladogram figures (Figs 3 and 4) generated using MacDraw II.

Material for each species is categorized according to type status; for named taxa the designation "non-type" refers to the principal study material, and the designation "additional material" refers to specimens that were merely identified as belonging to the taxon after the description had been finalized. The designation "non-type" for new taxa refers to material specifically excluded from type status because of morphological differences, disparate geographic location, or that the specimens were merely identified as belonging to the taxon after the description had been finalized.

Etymologies. Except where otherwise stated, epithets are generic names of cacti and allude to the spinose body surfaces of these isopods; these names are to be treated as nouns in apposition. The names were obtained from Riha and Subik (1987).

Terminology. The species of the genus are in many cases distinguished by the ornamentation of the antennule, epistome, and dorsal body surfaces. Particular terms have been coined to facilitate the description of these features (Fig. 1). *Spikes* — are hardened, usually acute cuticular processes, which occur on antennule peduncle articles 1 and occasionally 2, anterior margin of the cephalon, epistome, dorsal surface of pereonites, pleon and pleotelson, and also on the uropods; *tubercles* — are low rounded or acute processes, not always as prominent or hardened as spikes, restricted to the pleon and pleotelson; *pleonal boss* — the posteriorly expanded medial part of the pleon posterior margin. Antennule peduncle spikes are identified as (Fig. 1): anterior, posteroproximal, posteromedial and posterodistal .

Descriptions. The type species has been described in full detail, while descriptions of the remaining species contain the principal characters distinguishing species. A representative species typical of each species group has, where sufficient material was available, also been described in more than minimal detail. These species are: *O. tuberculosa* and O. *tripartita. Oxinasphaera bispinosa* and *O. islaya* sp. nov. Other distinctive species are similarly treated.

Abbreviations. AM, Australian Museum, Sydney; AMSBS, Australian Museum Shelf Benthic Survey; NMV, Museum of Victoria, Melbourne; TM, Tasmanian Museum and Art Gallery, Hobart; Qld, Queensland, Australia; QM, Queensland Museum, Brisbane; NTM, Northern Territory Museum, Darwin; SAM, South

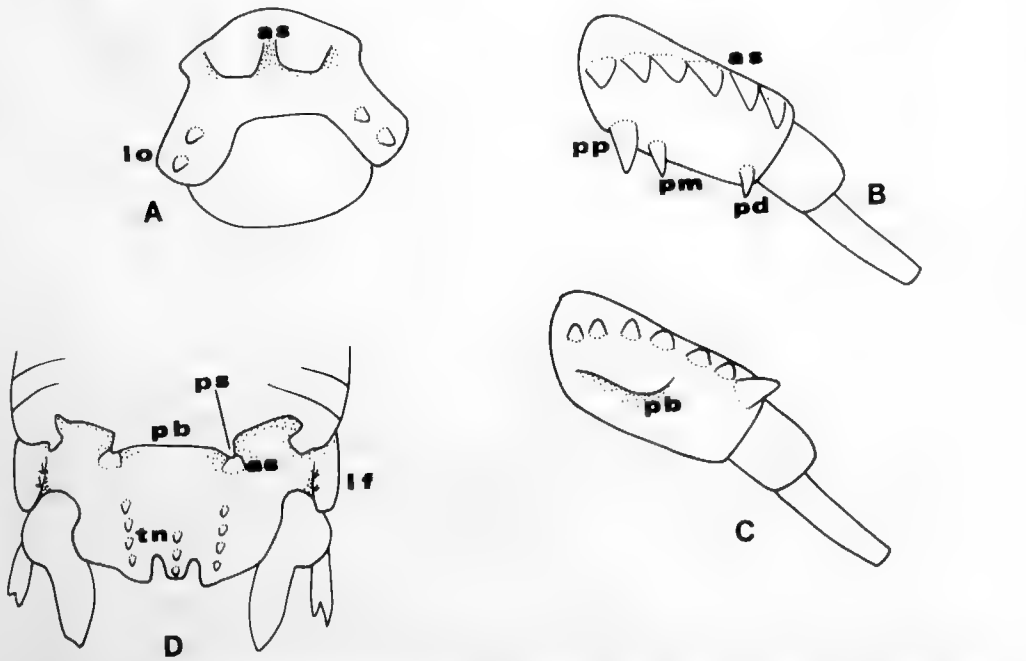


Figure 1. Terminology. A, epistome: as, anterior spikes (or anterior blade when a single transverse ridge); lo, lateral lobe. B, antennule: as, anterior spikes; pp, posterproximal spikes; pm, posteromedial spikes; pd, posterodistal spikes. C, antennule: anterior spikes irregular; pb, posterior blade; D, pleon and pleotelson: pb, posterior boss; ps, pleonal spike; as, anterior spike; tn, telson nodules; lf, lateral flange.

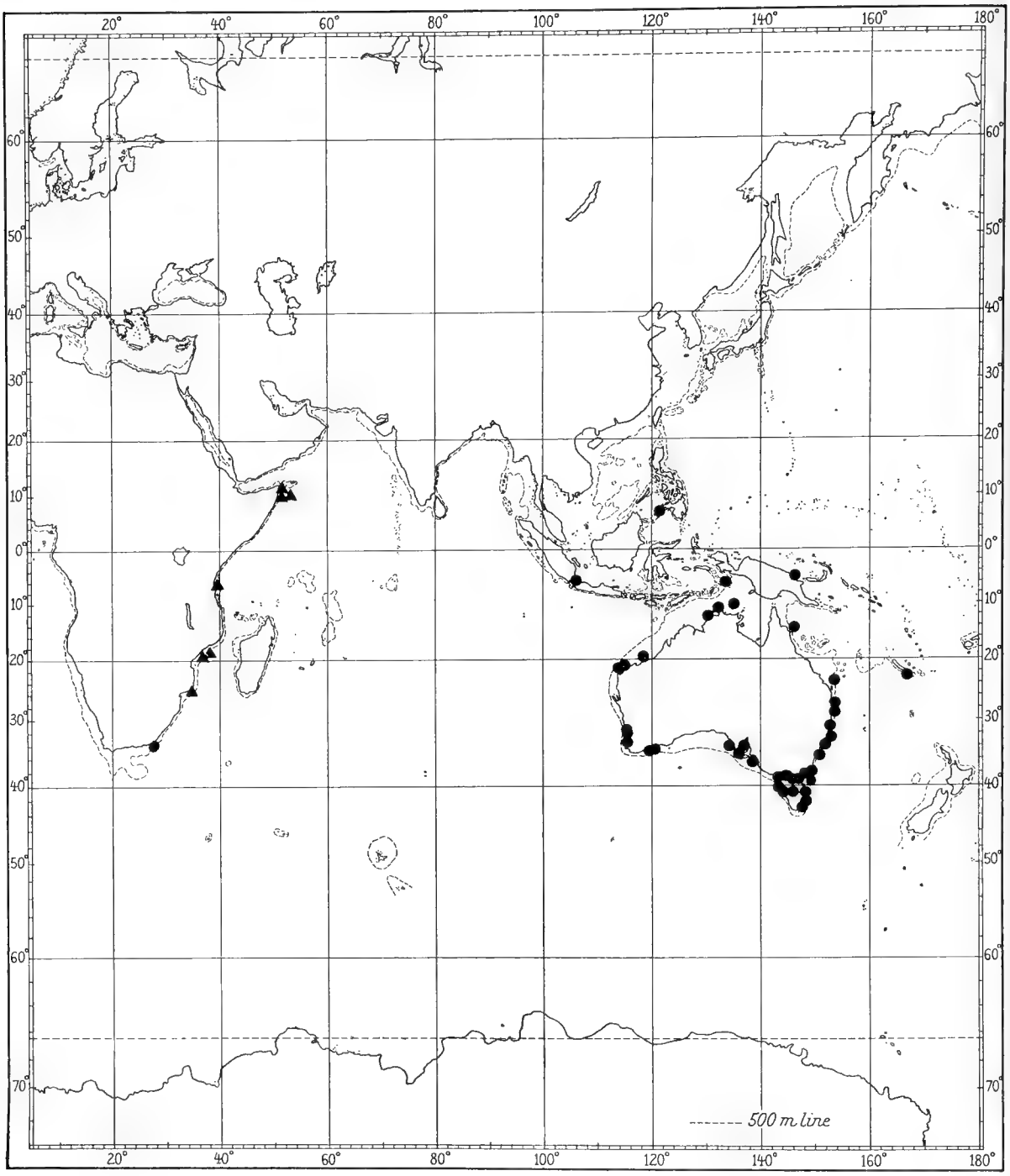


Figure 2. World-wide distribution of *Oxinasphaera*. Dots represent named species, triangles (western Indian Ocean) undescribed species.

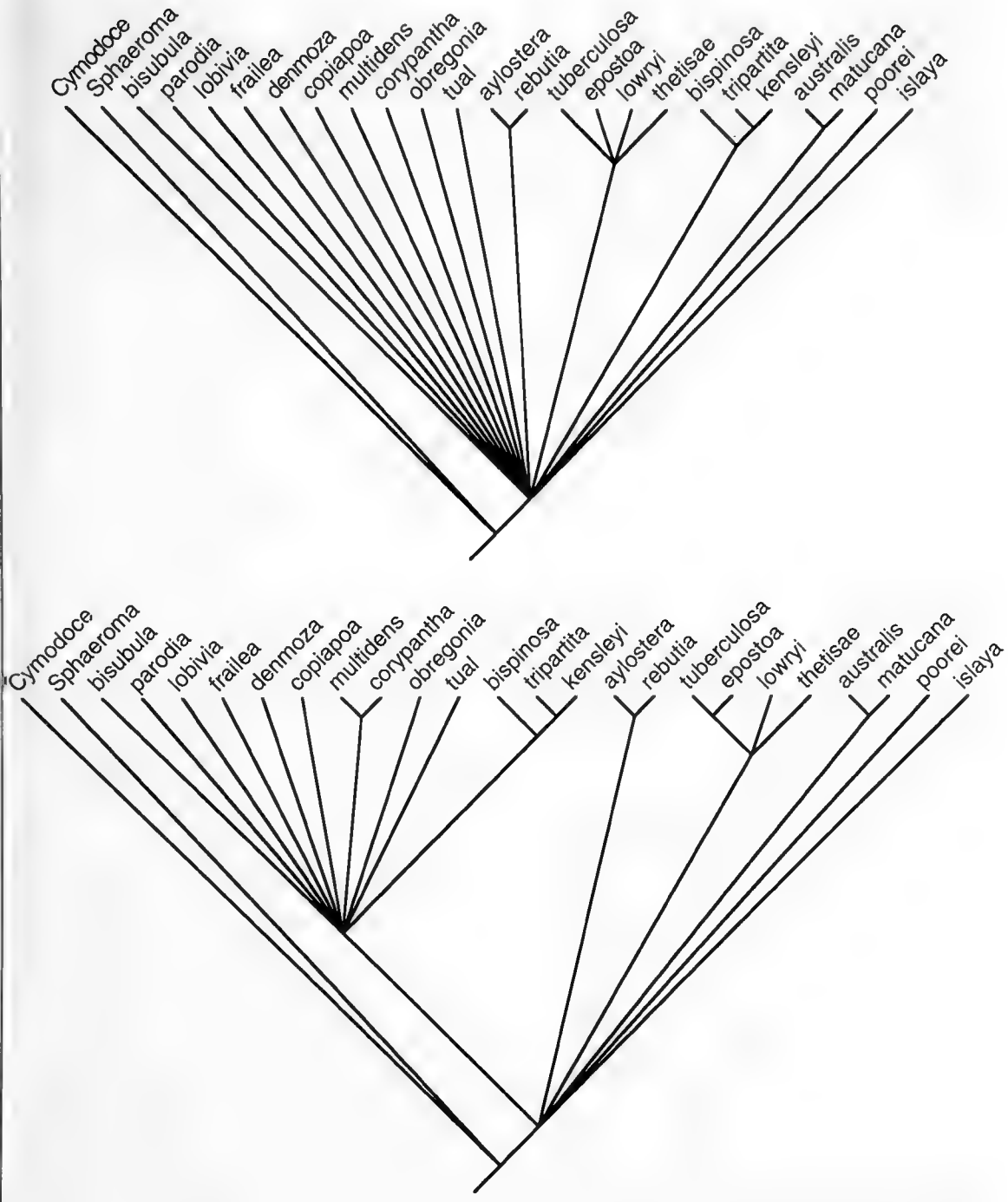


Figure 3. Cladograms of *Oxinasphaera*. A, strict consensus tree, unordered from 84 trees, length, 131; consistency index 0.260; retention index 0.349; homoplasy index 0.740; B, strict consensus tree, character 9 ordered, from 68 trees, length, 108; consistency index 0.315; retention index 0.503; homoplasy index 0.685.

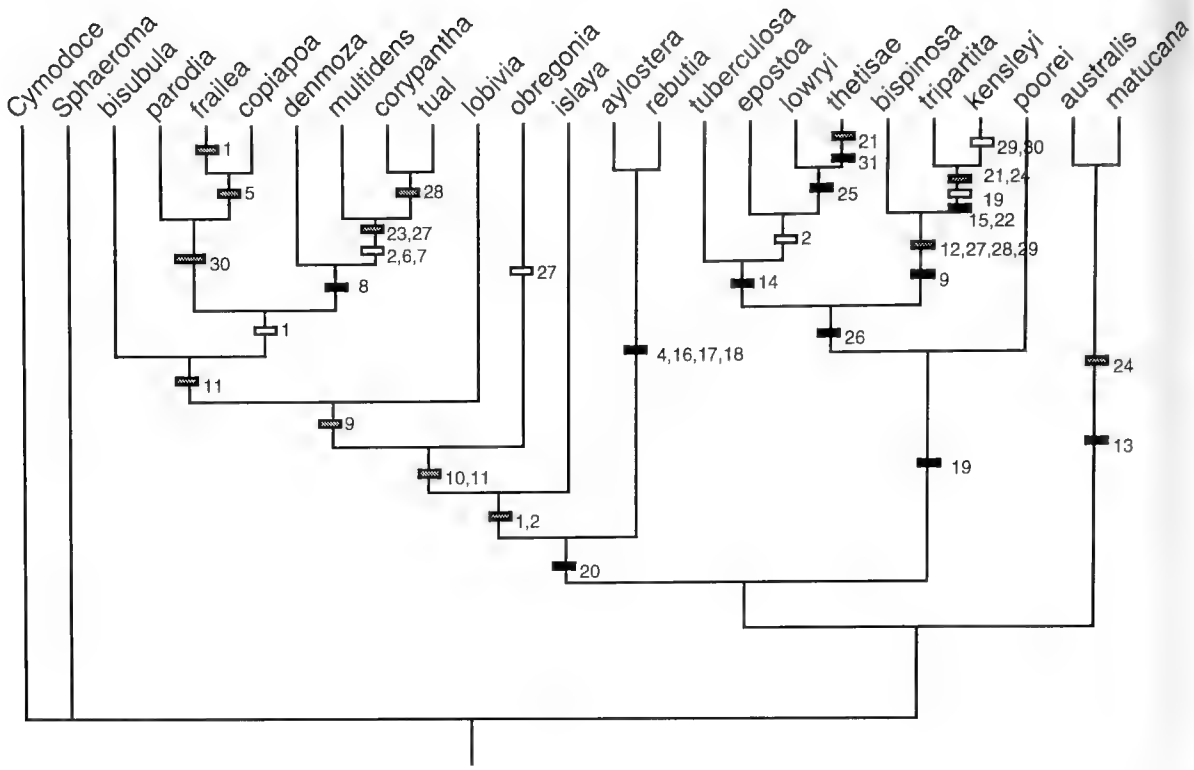


Figure 4. Cladogram of *Oxinasphaera* using successive character weighting. Length, 90; consistency index 0.378; retention index 0.624; homoplasy index 0.622. Solid bars = apomorphy, grey bar = homoplasy, white bar = reversal.

Australian Museum, Adelaide; SAfM, South African Museum, Durban; USNM, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA; WAM, Western Australian Museum; ZMUC, Zoologisk Museum, University of Copenhagen, Denmark.

PMS, plumose marginal setae; CP, circumplumose.

NSW, New South Wales; NT, Northern Territory; Qld, Queensland; SA. South Australia; Vic., Victoria; WA, Western Australia.

Sphaeromatidae Latreille

Sphaeromatinae Latreille

Recent publications have called into question the validity of characters on which the sphaeromatid subfamilies are diagnosed and the difficulty of their interpretation, in particular the presence and absence and development of pleopodal ridges (Bruce, 1993, 1994a, 1994b, 1995; Brusca and Wilson, 1991; Kussakin and Malyutina, 1993; Wägele, 1989). The subfamilies can currently only be considered to be delimited by their constituent genera. It is currently premature to offer a new diagnosis, and a thorough revision of the Sphaeromatidae will necessitate the relocation of many genera, and the development of new concepts for genera and of generic relationships within the family. Those comments notwithstanding, the new genus described here unequivocally belongs together with that group of genera that form the core of the subfamily Sphaeromatinae and includes, for example, the genera *Sphaeroma* Bosc, 1802, *Neosphaeroma* Baker, 1926, and *Cymodoce*. Two species in *Oxinasphaera*, *O. islaya* sp. nov., and *Oxinasphaera* sp. 1, lack pleopodal ridges.

The development of the ornamentation of the posterior margin of the pleon and pleotelson is as equally variable as the degree of development of the pleopodal ridges. Most species described here have the posterior margin with two submedian excavations, which may also be described as a median excavation in which lies a process (in some species either interpretation is valid), but one species (*O. islaya*) has an almost entire posterior margin, and two (*O. tripartita* and *O. kensleyi)* have a well developed dorsal

lobe overriding a median excision. In the *O. tuberculosa* clade of species the lobe appears dorsal to the posterior notch, but it does not override the notch.

In sphaeromatid taxonomy, the presence of posteriorly directed processes, single or paired, on the posterior margin of the pleon (or pereonite 6 or 7) has long been axiomatically considered to be of generic merit. The generic pairs of *Dynoides* Barnard, 1914 and *Clianella* Boone, 1923 or *Isocladus* Miers, 1876 and *Exosphaeroma* Stebbing, 1900, for example, are distinguished solely by the presence or absence of such a process which, as can be readily demonstrated, show intermediate conditions. Furthermore, such processes can readily be recognized as homoplasious, also occurring in apparently unrelated genera. In the genera *Dynoides* and *Clianella* two species, *D. brevispina* Bruce, 1980 and *D. brevicornis* Kussakin and Malyutina, 1987, have greatly reduced pleonal processes, which then leaves no distinguishing characters between these two genera. The recognition of autapomorphies should allow for a more meaningful interpretation of these variable and homoplasious characters. Such is the case for *Oxinasphaera*, in which the pleonal boss ranges from absent to with a pair of conspicuous elongate processes, but recognition of the diagnostic autapomorphies as the characters of significance allows the retention of those species within one genus.

Oxinasphaera gen. nov.

Type species. Oxinasphaera bisubula sp. nov., here designated.

Diagnosis of male. Pereonites 2–7 with 1 or 2 rows of distinct, usually acute spikes, segments 3–6 usually with 2 rows, anterior row of which is larger than posterior row. Pleotelson posterior margin medially excavate, with median process set within or above indentation, occasionally entire; without shallow open exit channel. Antennule peduncle article 1 anteriorly with row of prominent ventrally projecting spikes, posteriorly with 0–2 spikes. Epistome anterior margin with 1, or 1 pair of prominent ventrally projecting round acute or flat truncate spikes; posterolateral lobes with or without short spikes. Maxilliped palp article 2 medial margin strongly produced, articles 3–4 with medial margins greatly elongated (3–4 times as long as medial width) and finger-like, article 5 elongate, lying parallel to process of article 4; distolateral margins of articles 2–5 provided with abundant long setae which are distally finely pectinate. Pleopod 2 appendix masculina about as long as endopod, robust (4–9 times as long as maximum width), not extending beyond or only slightly beyond distal margin of ramus. Uropod attached midlaterally on pleon; exopod short, about half length of exopod, slender, apex deeply bifid, with 2 blade-like points; endopod projecting beyond posterior of pleotelson, round in section, not lamellar, apex with acute point and 1–3 prominent acute spikes, often with additional abundant tubercles.

Description of male. Dorsal surfaces of body granular and nodulose, often pilose. Cephalon anterior margin often with anterolateral row of acute spikes; laterally with distinct subocular groove, a continuation of an anterior ridge, second deep groove below the ridge; eyes large, facets distinct, with prominent posterior lobe. Coxae not distinctly demarcated. Pleon of 4 segments, segment 1 largely concealed by pereonite 7, segments 2–4 indicated by 2 distinct suture lines running to posterolateral margin of pleon; posteromedial margin of pleon with or without boss, with or without posteriorly directed processes. Pleotelson with anterolateral flange. Pleonal sternite present, weakly developed.

Antennule peduncle article 1 more than twice as long as 2, robust, article 3 slender, all articles collinear; flagellum about as long or slightly longer than peduncle, extending to about posterior of pereonite 1. Antenna peduncle article 1 short, articles 2 and 3 shorter than 4–5 which are longest; flagellum short, extending to about posterior of pereonite 1.

Epistome anteriorly acute, narrowly rounded or truncate, medially constricted. Labrum unornamented, may be nodulose or setose. Mandible incisor multicuspid; molar process prominent, crushing, provided with lateral scale teeth; left mandible with prominent lacinia mobilis; both mandibles with spine row of 5 or 6 spines; palp 3-articled, article 1 longest, 3 shortest. Maxillule lateral lobe with about 13 spines on gnathal surface, most of which are prominently serrate, with further 2 biserrate spines and distal surface; medial lobe with 4 prominently serrate and plumose spines, with further 2 short simple spines. Maxilla with all articles well developed, with prominent setae on lateral and middle lobes, medial lobe with several robust CP spines and additional slender spines. Maxilliped endite distal margin with 4 long laterally curving and 4 short CP spines, dorsal distolateral margin with 2–3 CP spines.

Pereopods all ambulatory, pereopods 1–3 subsimilar, and more robust than 4–7; posterior margins of merus and carpus with biserrate spines, without prominent setulose fringe; dactylus posterior margin with cuticular scale row, with prominent simple secondary unguis and 1 flattened seta arising at lateral base of secondary unguis; lateral margin with single seta ('propodal organ'), rarely with 2. Pereopods 6 and 7 posterior and distal margins of carpus with conspicuous biserrate and trifid spines.

Penes paired, unfused, medially adjacent at posterior of sternite 7, moderate to elongate in length, extending at least to pleopod peduncles; not conspicuously narrowed or acute.

Pleopods 1–3 both rami with PMS. Pleopod 1 endopod extending beyond exopod; exopod axis oblique to peduncle, with simple spine at proximolateral angle; peduncle with 3 coupling hooks on medial margin. Pleopod 2 with appendix masculina subbasally attached. Pleopods 3–5 exopods with entire transverse suture. Pleopods 4 and 5 exopods with thickened ridges or folds (rarely without), with lateral margin thickened, with row of short simple setae; endopods without thickened ridges or folds. Pleopod 5 exopod with 3 or 4 scale patches.

Female, ovigerous: Body with nodules weakly developed or absent; coxae visibly demarcated. Pleotelson posterior margin entire, upturned, with shallow ventral median depression, without exit channel. Mouthparts metamorphosed. Antennule peduncle article 1 anterior margin finely denticulate, without spikes. Pereopod 7 with spines simple or finely serrate, relatively longer and more slender than those of male. Uropod endopod flat, with apical point.

Brood pouch made up of short oostegites, overlapping slightly at mid-line, and arising from sternites 1–4; eggs held in internal pouches within body.

Female, non-ovigerous: Generally similar to ovigerous female, but may retain trace of male pleonal ornamentation, ventral margin of pleotelson posterior margin with ventrally flat rim, with median depression not reaching posterior margin, without exit channel; dorsal posterior margin not upturned. Mouthpart, pereopodal and pleopod morphology generally similar to that of male.

Remarks. The defining apomorphies for the genus are in the male: antennule peduncular article 1 with hardened prominent spikes on the anterior margin, epistome anteriorly with 1 or 2 hardened prominent spikes or transverse ridge; maxilliped palp articles 3 and 4 each with a greatly elongated medial margin, article 5 also greatly elongated, all with an obliquely truncate densely setose apex; posterodorsal margin of pereonites 2–7 with 1 or 2 rows of conspicuous spikes, uropod exopod with deeply bifid toothed apex and uropod endopod with hardened prominent spikes at ventrodistal apex. Additionally, the pleon and pleotelson are dorsally denticulate, the pleotelson usually with a divided posterior margin but without a distinct exit channel. The uropod rami are both round in section with the exopod about half as long as the endopod.

Species of this genus are easily recognizable by the males having the antennule peduncle article 1 with comb-like arrangement of prominent white downwardly directed spikes, similar prominent spikes on the epistome, and prominent spikes arranged in transverse bands across the dorsum of pereonites 2, 3, or 4–7. Other characters include the very nodular and setose body surfaces, deeply bifid short uropod exopod and cylindrical spiked uropod endopod.

The recognition of the autapomorphies for the genus allows recognition that the presence or absence of pleonal processes, and differences in morphology of the penial processes, appendix masculina, pleopodal ridges and pleotelson posterior margin are not necessarily of generic merit.

Distribution. Species of *Oxinasphaera* are found throughout the Indo-Pacific Ocean, with recorded localities from the south-western Indian Ocean at South Africa [*Oxinasphaera kensleyi* sp. nov.], to the Philippines in the north-east [*Oxinasphaera multidens* (Richardson, 1910) and *Oxinasphaera tripartita* (Richardson, 1910)], and to New Caledonia in the east (*Oxinasphaera corypantha* sp. nov.) (Fig. 2). The genus has been widely and commonly collected around the entire Australian coastline with the exception of some remote and difficult to collect localities. Usually collected within the continental shelf, but with one species (*Oxinasphaera parodia* sp.nov.) recorded from a depth of 400 metres. Several undescribed species exist in the North-western Indian Ocean, and are currently under study at the USNM (by B. Kensley and M. Schotte). Other Indo-Pacific regions may well yield further species once collections have been made, and at present I regard the distribution of the genus as incompletely known. The relatively well recorded sphaero-

matid fauna of New Zealand (Hurley and Jansen, 1977) apparently lacks representatives of this genus.

The single most commonly recorded or associated habitat for species of this genus is from, or with, sponges. It is probable that much of the collected material that has not been noted as being taken from sponges is the result of these animals exiting from their host once it has been collected. Large samples taken by trawl or epibenthic sled, such as some of those of *Oxinasphaera bispinosa*, may indicate that some species are also free living.

Etymology. The name is a combination of the Greek *oxina* (harrow or rake, alluding to the antennule peduncle morphology), with the ending *-sphaera*, indicating familial affinity (feminine).

Characters of taxonomic utility and general morphology

Cephalon. The cephalon is frequently ornamented, and may be posteriorly granular or pitted (e.g., Figs 11A-C) or smooth (Fig. 35A). The absence or presence, distribution and form of the spikes along the anterior margin, arrangement of rostral spikes (absent, single or double) and medial nodules should all be noted, the first two characters being critical in species evaluation.

Pereonites. Characters to note are: the arrangement of pereonal spikes, presence of prominent spikes on pereonite 1 or 2, and also which pereonites (e.g., 2–7, 3–7) have spikes. Spike rows are usually double (Fig. 11F), rarely single or triple, with the anterior row more prominent and smaller nodules between the spike rows (Fig. 43B); note also the shape of spikes.

Coxae. Coxae vary little between species, but differences can be seen in the posterolateral margins of 5 and 6, some species being rounded, others straight.

Pleon. There are several important and easily observed characters to note, particularly the presence or absence of posteriorly directed paired processes (Figs 43C, 47C), the presence of a posterior boss with paired lateral spikes (Fig. 11D), and the arrangement of the larger tubercles. The pleonal boss is usually distinct and armed with posteriorly directed spikes at each posterolateral corner. In some species the boss is altogether absent, while others lack a boss but retain the spikes, and in some the boss approaches the state of processes.

Pleotelson. There are a number of important characters to note, including the arrangement of anterior spikes and of the larger tubercles; most species have the dorsal surface covered with papillose nodules (Figs 11E, 14E, 43D), occasionally not evident (Fig. 16D); some species have longitudinal rows of prominent rounded nodules running from the posterior margin and median lobe (Fig. 35C). The shape of the posterior margin is usually with a median excavation in which lies a coplanar lobe. Other conditions of the pleotelson posterior margin are: posterior margin flat and produced with two submedian excavations; almost entire; with distinct dorsal lobe overlying median excavation; median lobe large, laterally flanked by deep grooves. The degree of setation should be noted.

Cuticle. The cuticle is variously polished, smooth or pitted, and ornamented in some form. Some species have papillose nodules (Figs 11C, E, 14F), while in others the nodules are simple (Fig. 21F) or absent (Figs 16F). *Oxinasphaera islaya* has large shallowly domed tubercles interspersed with smaller mushroom-shaped nodules (Fig. 58D). In most species the cuticle surface has scattered globular structures (Fig. 12H), also found in *Discidina* Bruce, 1994b (figs 54A, B). In only *Oxinasphaera bispinosa* were these observed to occur in distinct clearly defined pits (Fig. 43D).

Antennule. The morphology of antennular peduncle article 1 is critical in species discrimination. Characters to note are the number of anterior spikes, number and position of posterior spikes, presence of a posterior blade and whether spikes are regular or irregular. the presence or absence of spikes on antennule peduncular article 2 is useful to note. The relative length and the number of flagellar articles varies slightly between species.

Antenna. Details of the antennal peduncle and flagellum scarcely vary between species. The degree of setosity of peduncular articles 4 and 5, and number of flagellars article may vary.

Epistome. This character is of critical importance in discriminating species. It should be noted whether the spikes are round in section or antero-posteriorly flattened, close set or set apart, how many spikes are present, and whether the spikes are set on or form a transverse ridge; the presence of secondary spikes on lateral lobes should be noted.

Mouthparts. Mouthparts are consistently uniform throughout the genus and of little use in species discrimination. The mandible (Figs 11G, H, 43D, H) is of the typical generalized sphaeromatid form with a prominent lacinia mobilis on the left mandible, spine rows on both mandibles and a peripherally toothed molar with a flat unornamented surface. The maxilliped palp setae are terminally plumose (Fig. 12B). The endite dorsal surface has abundant setae, laterally with 3 large serrate setae (Fig. 44C).

Pereopods. Pereopods are generally very similar throughout the genus. Differences can be observed in the general robustness, number of spines on the propodal palm, and the relative length of both the carpal spines. Minor differences can be observed in the relative dimensions of the pereopods. The posterior margin of pereopods 1–3 is provided with biserrate spines (Fig. 12E), and distal margins of the carpus of pereopods 6 and 7 with biserrate and trifid spines (Fig. 44E). The dactylus has a robust secondary unguis with 2 associated setae (Figs 12C, 44D), the distolateral margin of the dactylus with a single seta (Fig. 21D) except for *O. lowryi* which has 2.

Penes. These generally extend to the pleopod peduncles. Some species have slender and elongate penes that fit into a groove on the medial margin of pleopod 1 endopod.

Pleopods. Pleopods are very uniform throughout the genus. Pleopod 1 endopod medial margin may be regular or with a ventral groove (when receiving elongate penial process), or with distomedial lobe. Pleopod 2 appendix masculina may be of even width or basally dilated, distally narrowed, straight or curving laterally; the apex varies from apically blunt to acute, usually slightly longer than exopod, in some species not extending beyond distal margin of endopod. Pleopod 5 has 3 patches of distally fringed scales, the distomedial patch being lobate (Fig. 44F, 44G).

Uropods. Often nearly identical among related species; characters to note are the relative length of the exopod in relation to the endopod, the size of the exopod spikes, the number and size of the distal exopod spikes, and the setosity of the rami. Uropodal setae are terminally roughened (Fig. 12F), a character which encourages silt to adhere to the animal. The uropod cuticle is similar to that of the pleotelson, the only appendage for which this is the case.

Relationships

Sister group relationships have yet to be clearly established in the Sphaeromatidae, and the monophyly of many of the larger genera is open to question. *Cymodoce* is one such genus, but the type species and a group of closely related species have been described in detail (Dumay, 1972a, b, c, d) allowing for a clear concept of the genus (*sensu stricto*, based on the type species) to be used when making outgroup comparisons. *Sphaeroma* was chosen as the second outgroup as it is a generally considered to be a monophyletic plesiomorphic genus, and was used to polarise pleon and pleotelsonic character states.

Cymodoce (*sensu stricto*) is regarded here as the sister group to *Oxinasphaera*. The genus *Cymodoce* has not been assessed in terms of cladistic criteria, and unambiguous synapomorphies with *Oxinasphaera* are difficult to identify, in part because the distribution of these characters beyond the genera in question is not known with certainty. Both genera have a similar mouthparts (particularly the elongate lobes of the maxilliped palp), pereopodal and pleopodal morphology, both commonly have some form of pleonal boss, and both have a median telsonic notch in which usually lies a simple coplanar lobe, all of which are potential syapomorphies. The two genera can immediately and easily be separated by the apomorphies identified (above) for *Oxinasphaera*, and also that *Cymodoce* (*sensu strictu*) has a lamellar and lanceolate uropodal exopod. Possible apomorphies for *Cymodoce* (*sensu stricto*) include the pleotelson with 2 subparallel longitudinal ridges, pleotelson apex with two submedian notches, pleotelson with a prominent hardened hemispherical dome anterior to the posterior pleotelsonic notches, uropod endopod flat and thickened (eastern Atlantic species) or cylindrical in section with a single distal apical spike (Australian species). Detailed discussion of characters states for *Cymodoce*, a large genus in desperate need of revision, is beyond the scope of the present study.

Character discussion

A generalized illustration of critical characters of the antennules and pleon is given in Fig. 1.

Cephalic spikes (characters 1 and 2): the anterior margin spikes are present in various degrees of prominence, and are scored 0 only when absent or so minute as to be indistinguishable from tubercles; *O. poorei* lacks spikes but

has a distinct anterior flange, and was recorded as ornamented (1) rather than unornamented (0); presence of 3 small rostral spikes was recorded as 1.

Pereonites (characters 3–8): records the spike configuration. Very small spikes are recorded as 0 for characters 5 and 6, although they are not absent. Character 8 is ambiguous, and not clearly definable.

Pleon (characters 9–11): character 9, posteriorly directed processes, was ordered, the paired processes being regarded as derived from a pleonal boss; the plesiomorphic state (smooth, no boss) is supported by outgroup comparison and also developmental evidence as postembryos, mancas and immature specimens lack the pleonal boss; paired processes cannot be derived directly from the plesiomorphic state, but the possibility of reversals from state 2 to state 1 is recognized. Posteriorly directed spikes (10) are the spikes at the anterolateral angles of the pleonal boss; lateral acute tubercles (11) are the small tubercles commonly present on the lateral margins of the pleonites 2, 3 and the lateral flange.

Pleotelson (characters 12–18): anterior spikes (12) are those that oppose the pleonal spikes or processes; the presence of a dorsal lobe (15) precludes characters 16 and 17, as the notch is without a median lobe ventrally.

Antennule (characters 19–23) and epistome (characters 24–26) record the spike configuration. The distinction between epistome spikes and a transverse blade is not always clear: in those species with paired acute spikes the spikes are often basally united and flattened; in those species with a blade the transition between a transverse series of tubercles, small spikes and a blade can be equally unclear.

Penes (character 27): penial processes in *Cymodoce* are elongate, but are short in *Sphaeroma*. The plesiomorphic condition is regarded as short and unfused.

Pleopods (characters 28–30): The plesiomorphic condition for pleopod 1 (28) is with a simple medial margin to the endopod as in *Sphaeroma*; in many genera and species the presence of a grooved medial margin is associated with elongate penial processes (e.g., *Cymodoce*), the penes fitting into the groove. This not always so, as shown by *O. obregonia* which has elongate penial processes but no pleopodal groove. The appendix masculina (29 and 30) in both outgroups is elongate and evenly tapered with a slender or narrowly rounded apex; being abruptly narrowed and having a blunt apex are both regarded as independent plesiomorphic states.

Uropod (character 31): *Sphaeroma* has lamellar uropods which lack terminal spikes. Indo-Pacific species of *Cymodoce* have the uropodal endopod similar to that of *Oxinasphaera*, but with a single terminal spike, and have a longer lamellar exopod that is not apically bifid.

Character list

Outgroups: *Cymodoce*, the probable sister group; *Sphaeroma*, a generalized plesiomorphic genus with regard to the pleon, pleotelson and uropods. * = characters with assumed polarity.

1. Cephalon anterior margin: unornamented (0); with distinct spikes or ridge (1).
2. Rostral spike: absent (0); single (1), double (2).
3. Pereonite 1: unornamented (0); nodular (1).
4. Pereonite 2: without prominent median nodule(s) (0); with prominent median nodule(s) (1).
5. Pereonite 2: without distinct spike rows (0); with distinct spike rows (1).
6. Pereonites 4–7: without distinct spike rows (0); with distinct spike rows (1).
7. Pereonites 4–7: spike rows subequal in size (0); anterior spike row larger than posterior (1).
8. Pereonite 7: posterior margin even (0); posterior margin weakly bilobed (1).
9. Pleon posterior margin: regular, even, not produced (0); posterior margin with medial boss (1), with posteriorly directed processes (2).
10. Pleon posterior dorsal surface: without spikes (0); with spikes (1).
11. Pleon posterolateral surface: without acute tubercles (0); with acute tubercles (1).
12. Pleotelson anterior margin: without pair of submedian spikes (0); with pair of submedian spikes (1).
13. Pleotelson posterior margin: not posteriorly flattened or extended (0); posteriorly flattened and extended (1).
14. Pleotelson posterior margin: entire (0); with simple shallow submedian notches (1), with median notch with deep submedian grooves (2).
15. Pleotelson posterior margin: without dorsal lobe (0); with dorsal lobe projecting over notch (1).
16. Pleotelson posterior margin: median lobe slender, extending to posterior margin (0);

median lobe short, distinctly rounded, not extending to posterior margin (1).
17. Pleotelson posterior margin: median lobe without distinctly rounded tubercle(s) (0); with such tubercles(s) (1).
18. Pleotelson posterior margin: shallow, flat in lateral view (0); deep-sided in lateral view (1).
19. Antennule peduncle article 1*: anterior spikes not markedly flat, distally acute (0); markedly flat, distally blunt or truncate (1).
20. Antennule peduncle article 1: prominent posterior spikes absent (0); prominent posterior spikes present (1).
21. Antennule peduncle article 1*: anterior spikes regular in size (0); anterior spikes irregular in size (1).
22. Antennule peduncle article 1: without posterior blade (0); with posterior blade (1).
23. Antennule peduncle article 2: without small anterior spike(s) (0); with small anterior spike(s) (1).
24. Epistome anteriorly*: with spikes (0); with transverse blade (1).
25. Epistome anteriorly*: with two spikes (0); with single spike (1).
26. Epistome anterior spikes*: acute, round in section (0); flattened, distally truncate (1).
27. Penial processes: short, robust (0); elongate, distally slender, extending to pleopod 1 peduncle (1).
28. Pleopod 1 endopod: medial margin simple (0); medial margin with dorsal groove (1).
29. Pleopod 2 appendix masculina: evenly tapered (0); distally abruptly narrowed (1).
30. Pleopod 2 appendix masculina*: distally acute (0); distally bluntly rounded (1).
31. Uropod endopod: with single prominent distal spike (0); with 2 or more prominent distal spikes (1).

Results of analysis

The matrix of 25 taxa by 31 characters was treated using the programme PAUP 3.1.1. Character transformations were investigated using the *apolist* option and examined using MacClade 3.03. The tree data is given in the captions to figures 3 and 4. Initially 84 trees were obtained, these being used to generate the strict consensus tree (Fig. 3A); with character 9 ordered weighted 68 trees were obtained, the strict consensus tree shown in Fig. 3B. The consensus trees are largely not dichotomously resolved, but the succesivley weighted tree (Fig. 3B) does demonstrate three distinct clades of the *O. bisubula* polychotomy, the *O. tripartita* clade and the *O. tuberculosa* clade. The successively weighted tree (Fig. 4, character 9 ordered) maintains the principal clades shown by the consensus tree, but the *O. tripartita* clade is shown as part of a larger clade with the *O. tuberculosa* clade. In both cases the level of homoplasy is high, with a homoplasy index of 0.685 and 0.622 respectively.

Discussion of trees

The strict consensus tree (Fig. 3B) demonstrates six dichotomously unresolved clades. The *O. bisubula* clade is defined by two apomorphies: prominent posterior antennule spikes (character 20) and the posterior margin with a boss (character 9). Both of these characters occur as homoplasies in other clades (*O. lowryi*, character 9) or are reversed within the clade (*O. bispinosa*, character 20, *O. obregonia*, character 9). Within this polychotomy there is a distinct clade consisting of the species *O. bispinosa*, *O. tripartita* and *O. kensleyi*. This clade is defined by the following apomorphies: pleon with posteriorly directed processes (character 9), elongate penial processes (character 27), and pleopod 1 endopod with a grooved medial margin (character 28). The latter two character states are homoplasious, character 27 occurring in *O. multidens*, *O. tual* and *O. obregonia*, and character 28 in *O. corypantha* and *O. tual*.

The *O. tuberculosa* clade is defined by the autapomorphies of the deeply grooved pleotelson posterior margin (character 14), flattened antennule spikes (character 19) and flattened epistome spikes (character 26). The latter two characters are homoplasious, also occurring in *O. bispinosa*.

Of the remaining smaller clades, the *O. aylostera/O. rebutia* clade is discussed below in relation to the successivley weighted tree, as is the *O. australis/O. matucana* clade. Both the single taxon clades of *O. poorei* and *O. islayi* inevitably lack unique apomorphies, although both species have a number of defining autapomorphies

The successively weighted cladogram (Fig. 4) supports the principal clades identified in the consensus tree, but differs in placing the *O. bispinosa* clade as sister group to the *O. tuberculosa* clade. The *O. bisubula* clade is defined by the unique appearance of posterior spikes on the antennule peduncle (character 20). The clade *O. aylostera* and *O. rebutia*, sister group to the remaining *O. bisubula* clade, is defined by

several autapomorphies: prominent nodules on pereonite 2 (character 4), pleotelson median lobe short (character 16), pleotelson median lobe with rounded tubercles (character 17), and the telson being deep in lateral view (character 18). The last two characters are somewhat weak and subjective, and the distribution and distinction of tubercles between species is equally subjective. Although the remaining species of the *O. bisubula* clade are dichotomously resolved, the relationships between these species is far from clear as the nodes are principally defined by homoplasies and reversals, while some of the characters (e.g., character 8) demonstrably show intermediate states.

The *O. tuberculosa* clade is defined by the unique appearance of flattened antennular spikes, although this character reverses in *O. tripartita* and *O. kensleyi*. The clade containing both the *O. tuberculosa* clade and *O. bisubula* clade is defined by the unique appearance of flattened spikes on epistome, again being reversed in *O. tripartita* and *O. kensleyi*.

The clade *Oxinasphaera australis* and *O. matucana* is defined by the posterior margin of the pleotelson being flattened and extended (character 13).

Relationships of the O. bispinosa *clade.* *Oxinasphaera tripartita* and *O. kensleyi* form a closely related species pair defined by the unique occurrence of a posterior blade on the antennule peduncle and the prominent pleotelsonic lobe that overrides the telsonic sinus. In common with *O. bispinosa*, the two species also have elongate penes, and pleopod 1 endopod with a grooved medial margin. All three species have elongate pleonal processes, a critical synapomorphic character. *Oxinasphaera bispinosa* retains the plesiomorphic condition for the pleotelson posterior margin, while the antennule and epistome spikes (characters 19 and 26) are apomorphic.

Oxinasphaera tripartita and *O. kensleyi* could not be scored for characters 14, 16, 17, 25, and 26. This species pair is also plesiomorphic for character 19, and therefore lacks the two defining apomorphies (characters 19 and 26) for the *O. tuberculosa* clade. Although the clade appears united by the apparent unique appearance of pleonal processes, close scrutiny of the morphology of these processes suggests that their occurrence in *O. bispinosa* and in the *O. kensleyi/tripartita* pair may also be homplasious. The shape of the processes in *O. bispinosa* is elongate and the processes are narrow and close-set, with a deep and narrow separation; and the apex is not hardened or spike-like (Figs 40A, 43C). In the *O. kensleyi/tripartita* pair the processes are short, narrowing rapidly to the apical point, widely separate, with a distally hardened (i.e., spike-like) apex (Figs 45A, 47B,C, 48 A,B). This, together with the change in position of the clade shown in the two trees (figs 3B, 4), suggests both that the position of this clade and of the species within it are yet to be fully resolved. It is of interest to note that all the western Indian Ocean species (USNM specimens, personal observation) have elongate pleonal processes.

Distribution of the major clades. The *O. tuberculosa* clade is restricted to Australian coastal waters with the species pair of *O. tuberculosa* and *O. epostoa* occurring on southern and northern tropical coasts respectively. The remaining species in this clade occur in south-eastern Australia.

The *O. bispinosa* clade has a disparate distribution. The species pair *O. tripartita* and *O. kensleyi* occur in the western Pacific and south-eastern South Africa respectively; *O. bispinosa* occurs in south-eastern Australia. Several other undescribed species occur in the western Indian Ocean but the relationships of these species require examination before any comments can be made on their distribution.

The *O. bisubula* clade occurs in Indo-Malayan region and the south-western Pacific. This group of species is absent from the western Indian Ocean and is also absent from south-western Australia.

Key to world species of *Oxinasphaera*

Notes: 1, the key identifies only males; females can be reliably identified only by association with males. 2, antennule, except where otherwise stated, refers to peduncular article 1.

1. Pleotelson posterior margin median lobe in dorsal position, set above posterior notch 2
— Pleotelson posterior margin median lobe in coplanar position, set within posterior notch or lobe absent 7

2. Pleotelson posterior margin median lobe not extending beyond posterior margin, flanked by deep grooves; antennule article 1 without posterior blade or spikes; penes short 3
— Pleotelson posterior margin median lobe extending beyond posterior margin, not flanked by deep grooves; antennule article 1 with posterior blade; penes elongate 6
3. Pleonal boss present; pereonites 6 and 7 with single row of spikes ..... *O. lowryi*, p. 202.
— Pleonal boss absent; only pereonite 6 with single row of spikes 4
4. Cephalon and pereonite 1 nodulose; pleon and pleotelson with numerous large spikes; epistome with single short truncate spike ..... *O. thetisae*, p. 205.
— Cephalon and pereonite 1 unornamented; pleon and pleotelson without numerous large spikes; epistome with 2 truncate spikes 5
5. Pereonites 2 and 3 densely nodulose; pereonite 7 with 2 spike rows; pleon and pleotelson sparsely setose *O. tuberculosa*, p. 195.
— Pereonites 2 and 3 weakly nodulose; pereonite 7 with 1 spike row; pleon and pleotelson densely setose ..... *O. epostoa*, p. 199.
6. Antennule with 5–7 irregular anterior spikes, elongate posterior blade; pleon posterior margin distinctly concave, processes without ventral spike ..... *O. tripartita*, p. 214.
— Antennule with 5 irregular anterior spikes, narrow posterior blade; pleon posterior margin weakly concave, processes with ventral spike ..... *O. kensleyi*, p. 218.
7. Pleotelson posterior margin entire, or medial lobe indistinct, very weak; uropod exopod with 3–4 prominent serrations..... ..... *O. islaya*, p. 237.
— Pleotelson posterior margin with distinct medial lobe; uropod exopod with ventral nodules only 8
8. Pereonal spikes flattened; cephalon anterior margin with distinct flange on either side of rostrum; antennule with 3 flat anterior and 1 large flat posteromedial spikes ..... *O. poorei*, p. 225.
— Pereonal spikes rounded; cephalon anterior margin with or without spikes on either side of rostrum; antennule with more than 3 anterior spikes 9
9 Pleon posterior margin with paired processes; epistome with 2 flat truncate spikes ..... *O. bispinosa*, p. 208.
— Pleon posterior margin without processes, with or without boss; epistome spikes rounded, distally acute 10
10. Pleon posterior margin with boss; pleotelson posterior margin flattened, somewhat produced; antennule without posterior spikes 11
— Pleon posterior margin regular, without boss; pleotelson posterior margin not flattened or produced; antennule with posterior spikes 12
11. Cephalon anterior margin with 3 prominent spikes, median one rostral; epistome with 3 short spikes; pereonite 1 unornamented, pereonite 2 weakly nodulose ..... *O. australis*, p. 218.
— Cephalon anterior margin unornamented; epistome with transverse blade; pereonite 1 with anterior pair of submedian nodules, pereonite 2 with 2 spike rows ..... *O. matucana*, p. 222.
12. Pleotelson medial lobe not extending to posterior margin; pereonites 1 or 1 and 2 with prominent median nodules; pleonal boss very weak 13

— Pleotelson medial lobe extending to posterior margin; pereonites 1 and 2 without prominent median nodules; pleonal boss very distinct 14

13. Rostrum with bifid spike; pereonite 1 unornamented; appendix masculina distally blunt ..... *O. aylostera*, p. 193.

— Rostrum without spike; pereonite 1 with prominent median rounded spike, 2 smaller nodules on either side; appendix masculina distally acute ..... *O. rebutia*, p. 191.

14. Cephalon rostral spike distinct and single or absent 5

— Cephalon with distinct bifid, or indistinct trifid rostral spike 18

15. Cephalon without rostral spike; cephalon anterior margin unornamented 16

— Cephalon with single rostral spike; cephalon anterior margin with small spikes 17

16. Pleotelson with 6 large posterolateral tubercles on either side; antennule article 2 with spike; appendix masculina not extending beyond distal margin of endopod ..... *O. multidens*, p. 184.

— Pleotelson without large posterolateral tubercles; antennule article 2 without spike; appendix masculina extending beyond distal margin of endopod ..... *O. corypantha*, p. 186.

17. Pleonal boss well developed, each angle with 2–3 distinct tubercles; antennule article 2 with single spike; pleopod endopod medial margin with distinct distomedial lobe; appendix masculina distal half abruptly narrowed ..... *O. obregonia*, p. 188.

— Pleonal boss weak, each angle with 1 tubercle; antennule article 2 without spike; pleopod endopod medial margin straight; appendix masculina not abruptly narrowed ..... *O. tual*, p. 188.

18. Rostrum with 3 indistinct small spikes; pleotelson posteriorly somewhat flattened ..... *O. copiapoa*, p. 181.

— Rostrum with 2 distinct spikes; pleotelson not posteriorly somewhat flattened 19

19. Anterior margin of cephalon unornamented; pleotelson without prominent posterior tubercles ..... *O. denmoza*, p. 178.

— Anterior margin of cephalon with spikes; pleotelson with or without prominent posterior tubercles 20

20. Anterior margin of cephalon with 4 prominent, discrete, acute spikes on either side of rostrum; appendix masculina apically irregularly truncated; medial margin of pleopod 1 endopod with stiff dense PS ..... *O. frailea*, p. 176.

— Anterior margin of cephalon with more than 4 spikes on either side of rostrum; appendix masculina apically rounded; medial margin of pleopod 1 endopod PMS not stiff 21

21. Anterior margin of cephalon with continuous row of 6–7 spikes on either side of rostrum; appendix masculina basally wide; pleonal boss with 2 prominent tubercles anterior to posterolateral angles ..... *O. lobivia*, p. 173.

— Anterior margin of cephalon with spikes most prominent laterally; appendix masculina not basally wide; pleonal boss without prominent tubercles anterior to posterolateral angles 22

22. Anterior margin of cephalon with spikes obvious; antennule with 6–7 anterior spikes; appendix masculina apically narrowly rounded; pleotelson with 2 prominent tubercles posterior to those opposing pleonal spikes ..... *O. bisubula*, p. 160.

— Anterior margin of cephalon with spikes weak; antennule with 8–9 anterior spikes; appendix masculina apically bluntly rounded pleotelson without prominent tubercles posterior to those opposing pleonal spikes ..... *O. parodia*, p. 170.

Oxinasphaera bisubula sp. nov.

Figures 5–12

Material examined. Holotype. ♂ (4.7 mm), eastern Bass Strait, 100 km NE of North Point, Flinders Is., Tas., 3852.6′S, 148°25.2′E, 15 Nov 1981, 130 m, fine sand, R. Wilson (NMV J40489).

Paratypes. **NSW.** 16♂ (3.8–5.1 mm, mean = 4.3 mm), 8♀ (ovig 4.3, 4.3, 4.0, 3.9, 3.8, non-ovig 4.3, 4.1, 3.5 mm), 3 mancas (2.5, 2.0, 1.8 mm), off Moona Moona Creek, Jervis Bay, 35°03.5′S, 150°41.0′E, 19 Jun 1982, 3 m, bivalves encrusted with sponges, J.K. Lowry (AM P41171, slide AM P44214). 3♂ (5.1, 3.9 mm), off Moona Moona Creek, Jervis Bay, 350°35′S, 150°41.0′E, 3 Mar 1982, 4.5 m, on ascidian, *Hermania momus*, in *Ecklonia*, P.B. Berents (AM P44199).

Bass Strait. 11♂ (5.0, 4.9, 4.9 SEM dissected, 4.8 SEM, 4.7, 4.5 dissected, 4.0, 4.0, 3.8, 3.5, 3.5 mm), 20♀ (3.8–4.5 mm), topotypes, same data as holotype (NMV J40490, 2♂, 2♀ ZMUC CRU1378). 3♂ (4.3, 4.1, 4.0 mm), 2♀ (ovig 4.5 damaged, dissected, 3.8 mm), 2 mancas (2.5, 1.1 mm), 28 km SSW of Marlo, Vic., 37°59.0′S, 148°27.0′E, 30 Jul 1983, 51 m, muddy sand and fine shell, M.F. Gomon and R.S. Wilson (NMV J26292). 2♂ (4.7, 4.6 mm), 65 km E of Cape Rochon, Three Hummock Is, Tas., 40°10.9′S, 145°23.0′E, 13 Nov 1981, 75 m, shelly sand, R.S. Wilson (NMV J40491). ♂ (4.4 mm), 20 km NNE of North Point, Tas., 40°38.0′S, 144°20.9′E, 4 Nov 1980, 37 m, muddy shell grit, M. Gomon and G.C.B. Poore (NMV J26282). 6♂ (4.6, 4.4, 4.3, 4.3, 4.2, 4.0 mm), 100 km SSE of Cape Liptrap, Vic., 39°45.9′S, 145°33.3′E, 13 Nov 1981, 74 m, muddy fine sand, R. Wilson (NMV J26257). 2♂ (4.2, 4.0 mm), 36 km SSW of Stokes Point, King Is, Tas., 22 Nov 1981, 85 m, medium sand, dredged, R.S. Wilson (NMV J4097).

Vic. 3♂ (4.8, 4.4, 4.0 mm), 6♀ (4.8, 4.4, 4.0, 3.7, 3.5, 3.3 mm), 8 mancas (2.8–0.9 mm), NE shore of Cape Wellington, Wilsons Promontory, 39°3.5′S, 146°28.7′E, 9 Feb 1982, 0 m, various SCUBA samples, G. Smith and L. Rubleman (NMV J26317). 3♂ (4.9, 4.9, 4.8 mm), female? (2.0 mm), Bastion Point, Mallacoota, 37°34.3′S, 149°46.2′E, 6 Apr 1989, 5 m, reef 300 m offshore, hydroids, sponges, bryozoans and red algae, G.C.B. Poore and R.S. Wilson (NMV J26366). 4♂ (4.6, 4.3, 4.3, 4.0 mm), Bastion Point, Mallacoota, 37°34.3′S, 149°46.2′E, 6 Apr 1989, 5 m, reef 300 m offshore, sponges, G.C.B. Poore and R.S.. Wilson (NMV J26402).

Tas. 9♂ (4.1–3.5, mm), 4♀ (4.2, 4.0, 4.0, 4.0 mm), eastern side of Waubs Bay, Bicheno, 41°53′S, 147°18′E, 23 Mar 1988, 7 m, reef, sponges on vertical rock face, SCUBA, G.C.B. Poore and H.L. LewTon (NMV J26238).

Non-paratypic material: **Qld.** 2♂, off Moreton Bay, 27°27′S, 153°39′E, 29 Mar 1969, 76.8 m, W.F. Ponder on HMAS *Kimbla* (AM P44200).

NSW. ♂, Nelson Head, Port Stephens, 32°43′S, 152°09′E, 27 Oct 1980, 24 m, rubble stones in channel, J. Hall (AM P41173). ♂, 5♀, N of Fly Point, Nelson, 32°43′S, 152°09′E, 8 Nov 1981, 20 m, orange sponge on dead mussel, R.T. Springthorpe and D. Stracy (AM P44211). ♂, 2♀, 6 mancas, Fly Point, Nelson Bay, 32°43′S, 152°09′E, 28 Oct 1980, 15 m, algae, J. Hall (AM P41194). 2♂, 6♀, 1 manca, Nelson Head, Port Stephens, 32°43′S, 152°10′E, 27 Oct 1980, 18 m, sand and shell grit, J. Hall and I. Loch (AM P41178). 2♂, 11♀ (3 ovig), 7 mancas, Nelson Head, Port Stephens, 32°43′S, 152°09′E, 27 Oct 1980, 18 m, tufted bryozoans and hydroids, J. Hall (AM P41190). 6♂, 6♀(3 ovig), 6 mancas, inside Box Head, Broken Bay, 33°33′S, 151°21′E, 22 Nov 1982, two species of sponges, J.K. Lowry and R.T. Springthorpe (AM P41174). ♂, inside Box Head, Broken Bay, 33°33′S, 151°21′E, 21 Nov 1982, from *Echinoclathria* sp., J.K. Lowry and R.T. Springthorpe (AM P44209). 5 ♂, E of North Head, Port Jackson, Sydney, 33°49′S, 151°18′E, 19 Feb 1973, 19 m, host *Teichonella labrinthica*, AMSBS (AM P22191-P22194). 2♂, E of North Head, Port Jackson, Sydney, 33°49′S, 151°18′E, 1973, 42 m, host *Polymastea craticia*, AMSBS (AM P22197). 2♂, same data as previous except 19 m, 19 Feb 1973 (AM P22190). 3♂, same data as previous except 32.9 m, 23 May 1973 (AM P22198). 9♂, E of North Head, Port Jackson, Sydney, 33°49′S, 151°18′E, AMSBS (AM P24307). ♂, ovig ♀, Port Hacking, Sydney, 34°03.9′S, 151°07.6′E, 11 Jul 1971, 18 m, rock face, P.A. Hutchings (AM P41203). 2♂, 2 ovig ♀, Port Hacking, Sydney, 34°05′S, 151°10′E, 13 Aug 1981, 15 m, sponge, J.K. Lowry and R.T. Springthorpe (AM P41167).♂, 4♀, off Moona Moona Creek, Jervis Bay, 35°03′S, 150°41′E, 13 May 1981, 17.7 m, from sponge in scallop beds, P.B. Berents (AM P41192). 5♂, 2 ovig ♀, off Moona Moona Creek, Jervis Bay, 35°03.5′S, 150°41.0′E, 19 Jun 1982, 8 m, mussels, epizoic algae and sponges on sand covered rocks, J.K. Lowry (AM P41169). ♂, ♀, 8 immature and mancas, off Moona Moona Creek, Jervis Bay, 35°03′S, 150°41′E, 19 Jun 1982, 3 m, from sponges, J.K. Lowry (AM P44194). ♂, 8♀, off Moona Moona Creek, Jervis Bay, 35°03.5′S, 150°41.0′E, 19 Jun 1982, 3 m, encrusting sponge, J.K. Lowry (AM P41170). 2 ♂, ocean side of Bowen Is., Jervis Bay, 35°07′S, 150°46′E, 27 Apr 1971, 36 m, sponges, ascidians, bryozoans and algae from large boulders, P.A. Hutchings and P.B. Weate (AM P41195). 5♂, ovig ♀, ocean side of Bowen Is., Jervis Bay, 35°07′S, 150°46′E, 29 Nov 1971, 36.5 m, marine growth on boulders, P.A. Hutchings (AM P44205). 30+ ♂, ♀, Darling Point, Jervis Bay, 35°07.6′S, 150°45.6′E, 23 Jan 1973, 18 m, scallops and mussels on sandy bottom, P.A. Hutchings (AM P41204). ♂, several ♀ and imm, 37°05′S, 150°05′E, 30 Nov 1914, 55–91 m, sand, Dr Th. Mortensen's Pacific Expedition 1914–1916, *Endevour* (ZMUC CRU1379).

Vic. 4♂, 9♀ , 50 nm SE of Gabo Is., 37°22.3′S, 150°02.2′E, 19 Jun 1962, 75 m, HMAS *Gascoyne* (AM P41181). ♀, Gabo Is., 37°34′S, 159°55′E, 19 Feb 1973, 28 m, sponge community, J.E.Watson and S.A. Shepherd (NMV J40496). ♂, Gabo Is., 37°34′S, 159°55′E, 17 Feb 1973 (NMV J26216). 2♂, 2 mancas, 20 miles SW of Cape Everard, 37°48′S, 149°16′E, 27 Aug 1972 (NMV J26219).

Bass Strait. ♂, 31 km SSW of Cape Otway, Vic., 39°08′S, 143°24′E, 8 Oct 1980, 77 m, medium sand, G.C.B. Poore (NMV J26253). 2♂, 23 km E of Cape Rochon, Three Hummock Is., Tas., 40°22.2′S, 145°17.0′E, 3 Nov 1980, 40 m, mainly sand,

M. Gomon and G.C.B.Poore (NMV J26266). ♂, 47 km E of Cape Rochon, Three Hummock Is., Tas., 40°23.8′S, 145°32.0′E, 3 Nov 1980, 66 m, muddy sand, M. Gomon and G.C.B.Poore (NMV J26289).

Tas. ♂, 2♀, 32 km NW of Devenport, 40°56.04′S, 146°39.00′E, 4 Feb 1980, 66 m, muddy sand, M. Gomon and G.C.B. Poore (NMV J40482). 8♂, 16♀ and imm, 39 km NNE of Devenport, 40°49.75′S, 146°31.33′E, 4 Feb 1980, 68 m, mud with bryozoa and sponges, M. Gomon, G.C.B. Poore and C.C. Lu (NMV J40492). ♂, ♀, 1 km E of Bicheno, Muirs Rock, 41°53.0′S, 148°19.0′E, 21 Apr 1985, 15 m, sponge and bryozoan epifauna, airlift, R.S. Wilson (NMV J26144). ♂, same data as previous, except from red algal turf, infauna (NMV J 26145). Many, D'Entrecasteaux Channel, 2.5 km E of Birches Bay, 43°11.0′S, 147°16.0′E, 16 Apr 1985, 10 m, R.S. Wilson (NMV J26140).

Australian Museum, Old Collections. 9♂, 9 km E of Coogee, NSW, 33°57′S, 151°21′E, 15 Mar 1898, 89 m, fine sand, E.R. Waite on HMCS *Thetis* (AM G2274). ♂, 2 km E of Orient Point, NSW, 34°13′S, 150°48′E 20 Mar 1898, 23 m, sand and rock, E.R. Waite on HMCS *Thetis* (AM G2273). 5♂, Thetis stn 48, E.R. Waite (AM G3902).

Description of male. Body about 2.2 times as long as greatest width; lateral margins subparallel, maximum width at pereonites 5; dorsal surfaces not polished, generally finely pitted anteriorly, otherwise granular, with scattered setae. Cephalon dorsal surface finely nodulose; anterior margin with series of 5–7 discrete acute tubercles on either side of rostrum, lateralmost being most prominent; with prominent bifurcate spike on rostrum. Pereonite 1 without spikes or ornamentation. Pereonites 2 and 3 each with 2 fine transverse rows of low spikes, pereonites 4–7 each with 2 transverse rows of prominent acute spikes, anterior row larger than posterior row; coxae 5–7 with posterior margins evenly rounded. Pleon posterior margin with posterior boss, posterolateral angles of boss each with prominent posteriorly directed spikes. Pleotelson with 2 prominent spikes opposing those of pleon, pair smaller tubercles set immediately posterior to these; posterolateral flange with 1 submarginal and 2 marginal acute tubercles; posterior margin with two prominent submedian indentations either side of median lobe.

Antennule peduncle article 1 with 6 (occasionally 7) anterior spikes; with 1 long proximoposterior spike and 1 short posterior spike; dorsal surface of peduncular articles 1 and 2 provided with numerous roughened setae; flagellum with 6 articles. Antenna peduncle articles 4 and 5 with long setae; flagellum of about 7 articles.

Epistome with 2 prominent widely separated conical spikes set on transverse ridge. Mandible spine row with 5–6 spines; molar process toothed along margins, surface finely ridged, distal margin not deeply indented; palp article 2 with 7 stout biserrate setae on medial margin, distal 2 being longest, article 3 with 8 short and 4 long stout biserrate setae on medial margin. Maxilla lateral lobe with 9 finely pectinate setae, middle lobe with 6, medial lobe with 5 CP spines and distally a further 6 weakly plumose setae.

Pereopod 1 basis about 2.5 times as long as wide, anterior margin with 2 sensory setae; ischium 0.7 times as long as basis, 2.2 times as long as wide, anterior margin with 2 short proximal spines and 1 distal longer and biserrate spine; merus about half as long as ischium, 1.2 times as long as wide, anterolateral angle with 2 gently curving pectinate spines, posterior margin with 3 spines becoming progressively longer distally and single long simple seta; carpus short, 0.7 times as long as merus, 1.2 times as long as wide, posterior margin with 2 biserrate spines; propodus about equal in length to ischium, widest proximally, about 2.8 times as long as wide, posterior margin with distinct scale spikes and 3 large biserrate spines, row of 3 smaller biserrate spines on medial margin; dactylus 0.6 length of propodus, unguis about 44% length of entire dactylus. Pereopods 2 and 3 similar to 1, differing principally in having the carpus more elongate and propodus more slender. Pereopod 2 basis 3.0 times as long as wide; ischium 2.5 times as long as wide; carpus about equal in length to merus, 1.4 times as long as wide, with further 5 biserrate on distal margin; propodus 0.8 times as long as ischium, 2.9 times as long as wide, margins subparallel, posterior margin with weakly biserrate spines. Pereopods 4–7 generally subsimilar except 6 and 7 provided with more biserrate spines on carpus than 4 and 5. Pereopod 6 similar to 7 except basis slightly longer, carpus distal margin with 3 large trifid spines Pereopod 7 basis 2.5 times as long as wide, posterior margin with prominent scale spikes, with several sensory setae; ischium slightly shorter than basis, 3.7 times as long as wide; merus 0.4 times as long as ischium, 3.7 times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 1 large spine; carpus 1.4 times as long as merus, 2.3 times as long as wide, posterior margin with 6 biserrate spines, distal margin with 2 large trifid spines and 6 biserrate spines; propodus about 1.2 times as long as carpus and 0.6 time as long as ischium, about 3.5 times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 2 sensory setae.

Penial processes each about 3.5 times as long as basal width, tapering slightly to an oblique

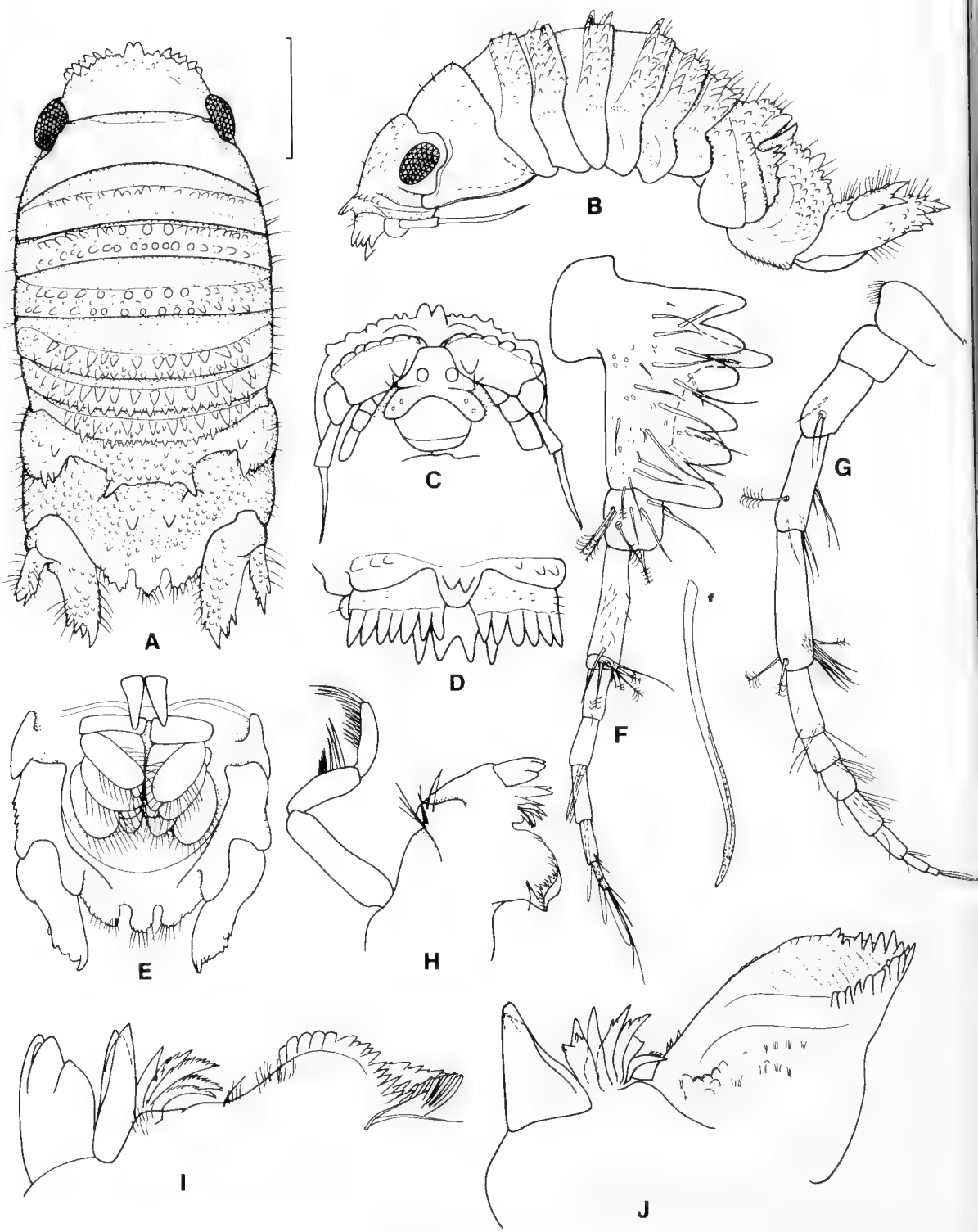


Figure 5. *Oxinasphaera bisubula* sp. nov. A–E, holotype, remainder paratype ♂ 4.5 mm (NMV J40490). A, dorsal view; B, lateral view; C, frons; D, cephalon and antennules, anterior view; E, pleon and pleotelson, ventral view; F, antennule, f, seta from peduncular article 1; G, antenna; H, left mandible; I, left mandible, distal detail; J, right mandible, distal detail. Scale 1.0 mm.

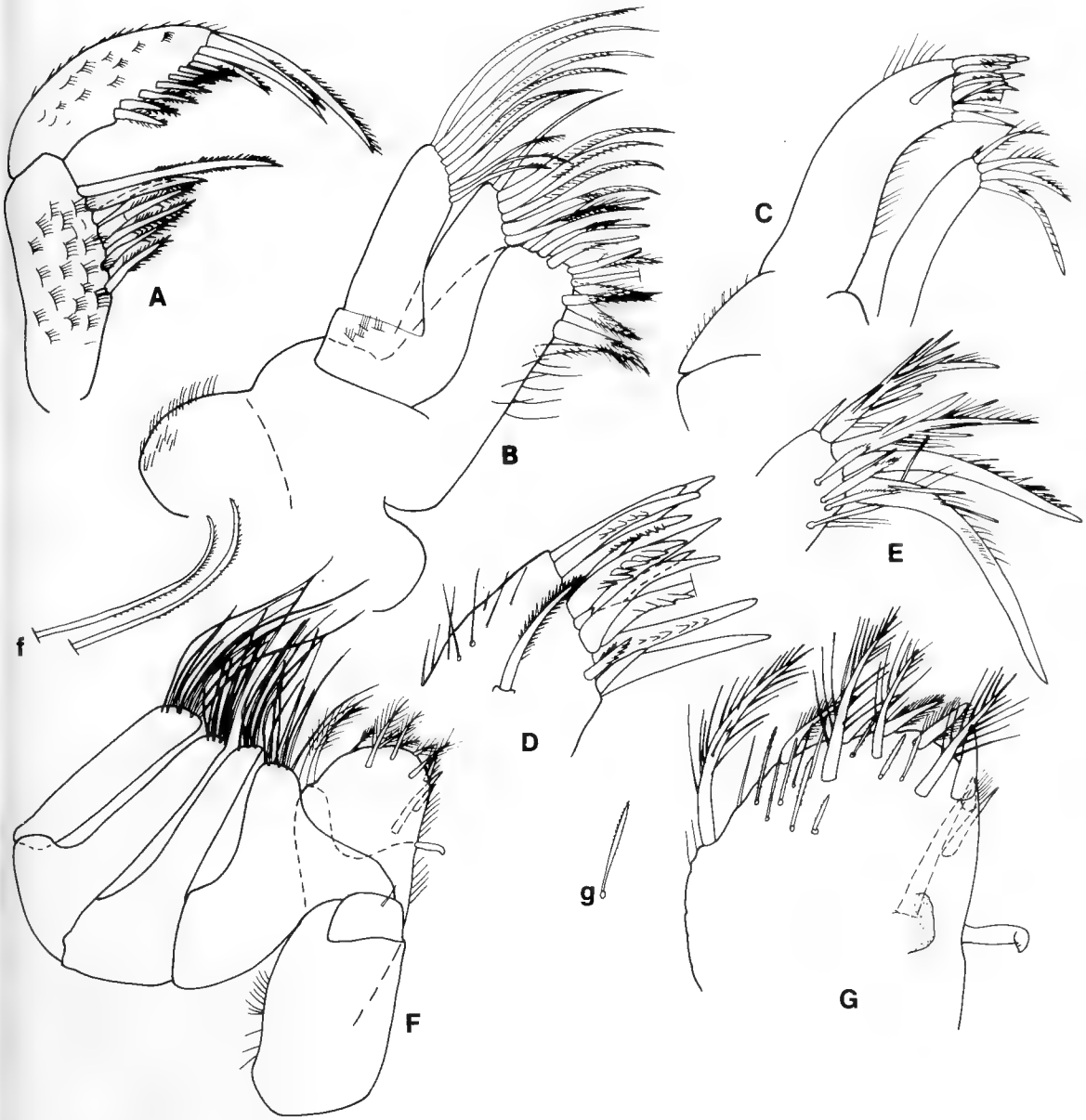


Figure 6. *Oxinasphaera bisubula* sp. nov. All figs paratype ♂ 4.5 mm (NMV J40490). A, mandible palp; B, maxilla; C, maxillule; D, maxillule exopod apex; E, maxillule endopod apex; F, maxilliped, f, seta from palp article 5; G, maxilliped endite distal margin, g, cuticular setule from endite.

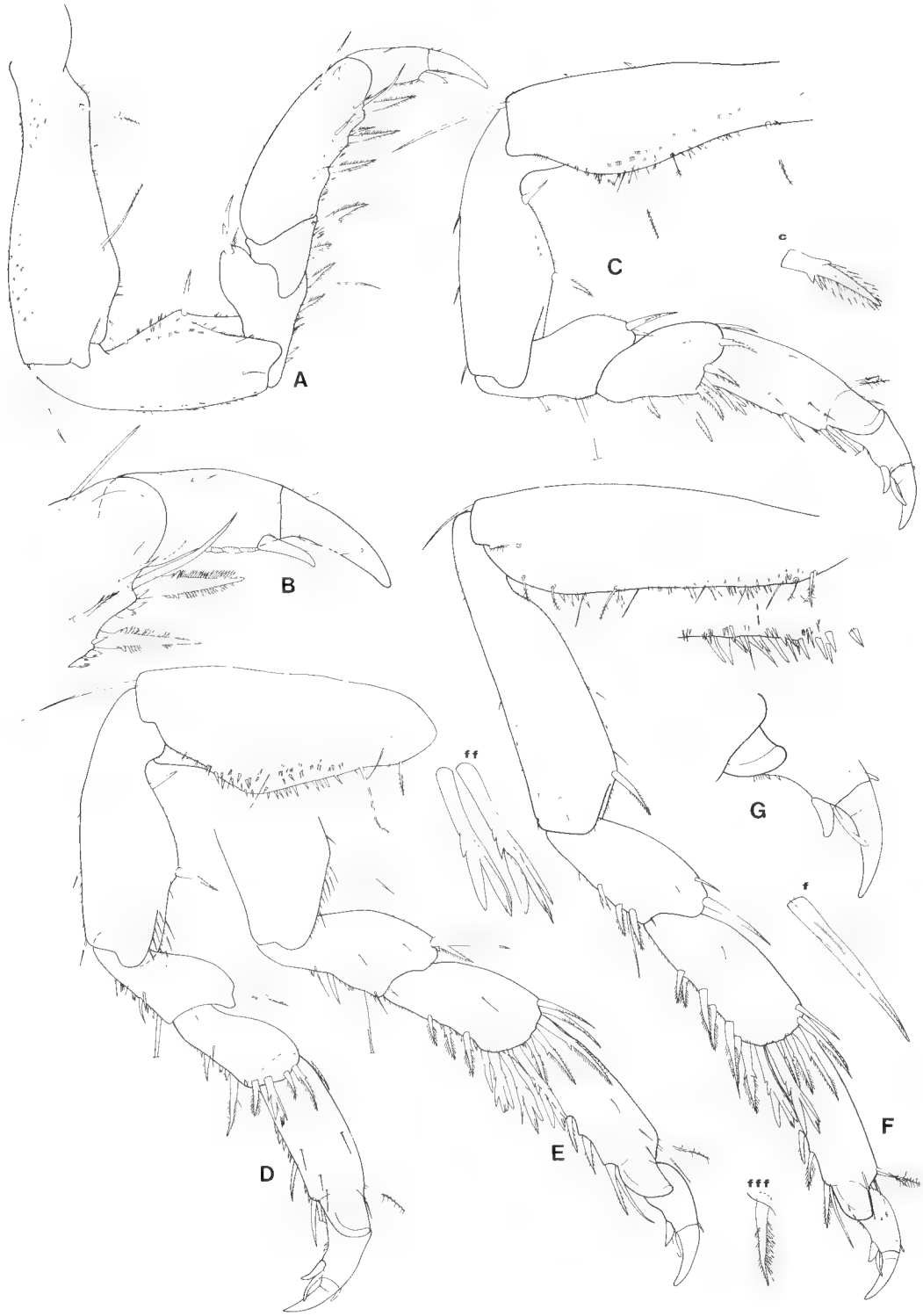


Figure 7. *Oxinasphaera bisubula* sp. nov. All figs paratype ♂ 4.5 mm (NMV J40490). A, pereopod 1; B, pereopod 1, dactylus; C, pereopod 2; D, pereopod 3; E, pereopod 6, distal articles; F, pereopod 7, f, spine from anterodistal angle merus, ff, spines from distal margin carpus, fff, spine from posterior margin of merus; G, pereopod 7, dactylus medial view (a, anterior margin; b, posterior margin).

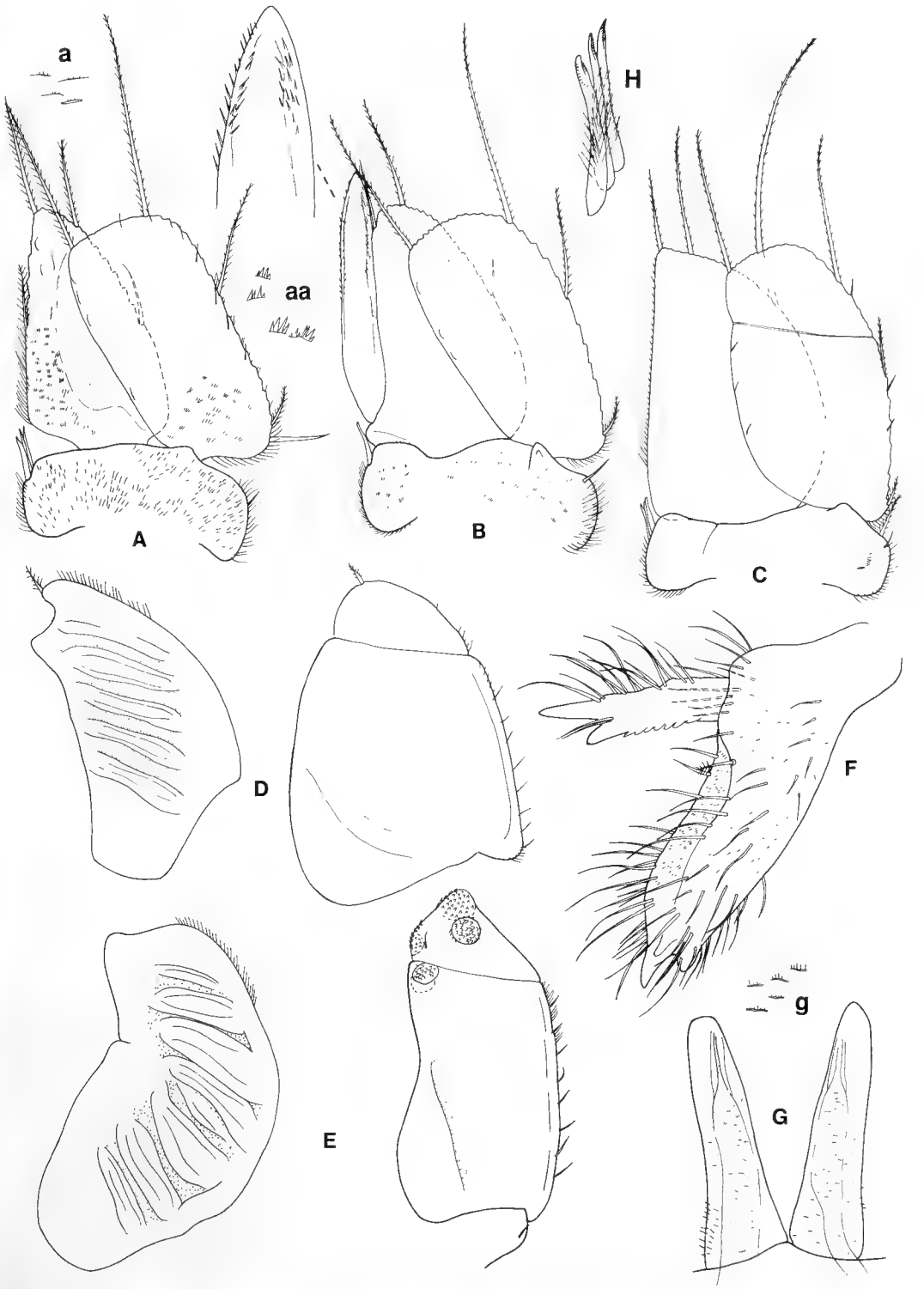


Figure 8. *Oxinasphaera bisubula* sp. nov. All figs paratype ♂ 4.5 mm (NMV J40490). A–E, pleopods 1–5 respectively, a, scales from endopod, aa, scales from exopod; F, uropod; G, penes, g, scales from base of penes; H, coupling hooks, pleopod 1.

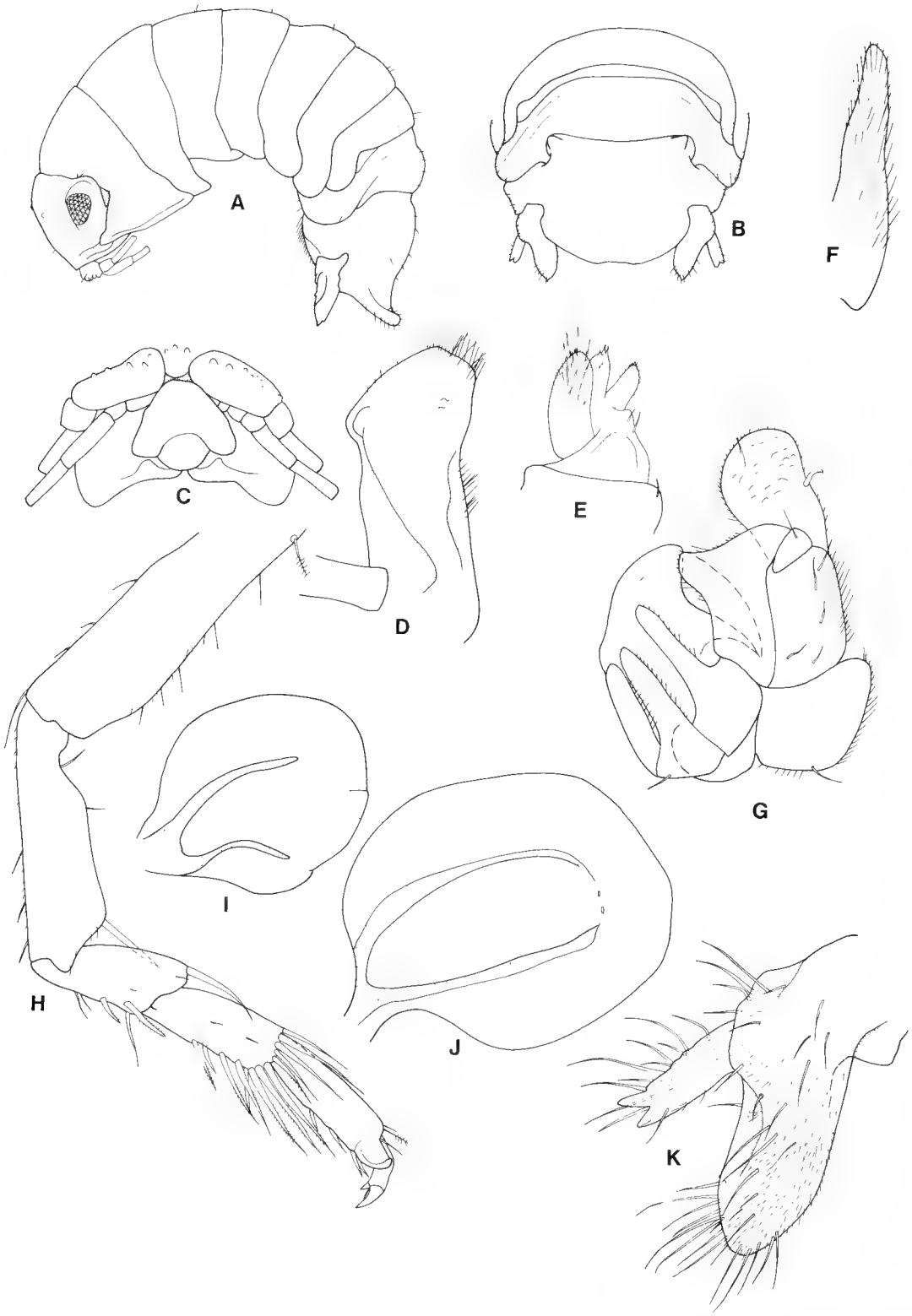


Figure 9. *Oxinasphaera bisubula* sp. nov. Ovigerous ♀ 4.5 mm (NMV J26292). A, lateral view; B, dorsal view of pleon and pleotelson; C, frons; D, mandible; E, maxillule; F, maxilla; G, maxilliped; H, pereopod 7; I, oostegite 1; J, oostegite 4; K, uropod. Scale 1.0 mm.

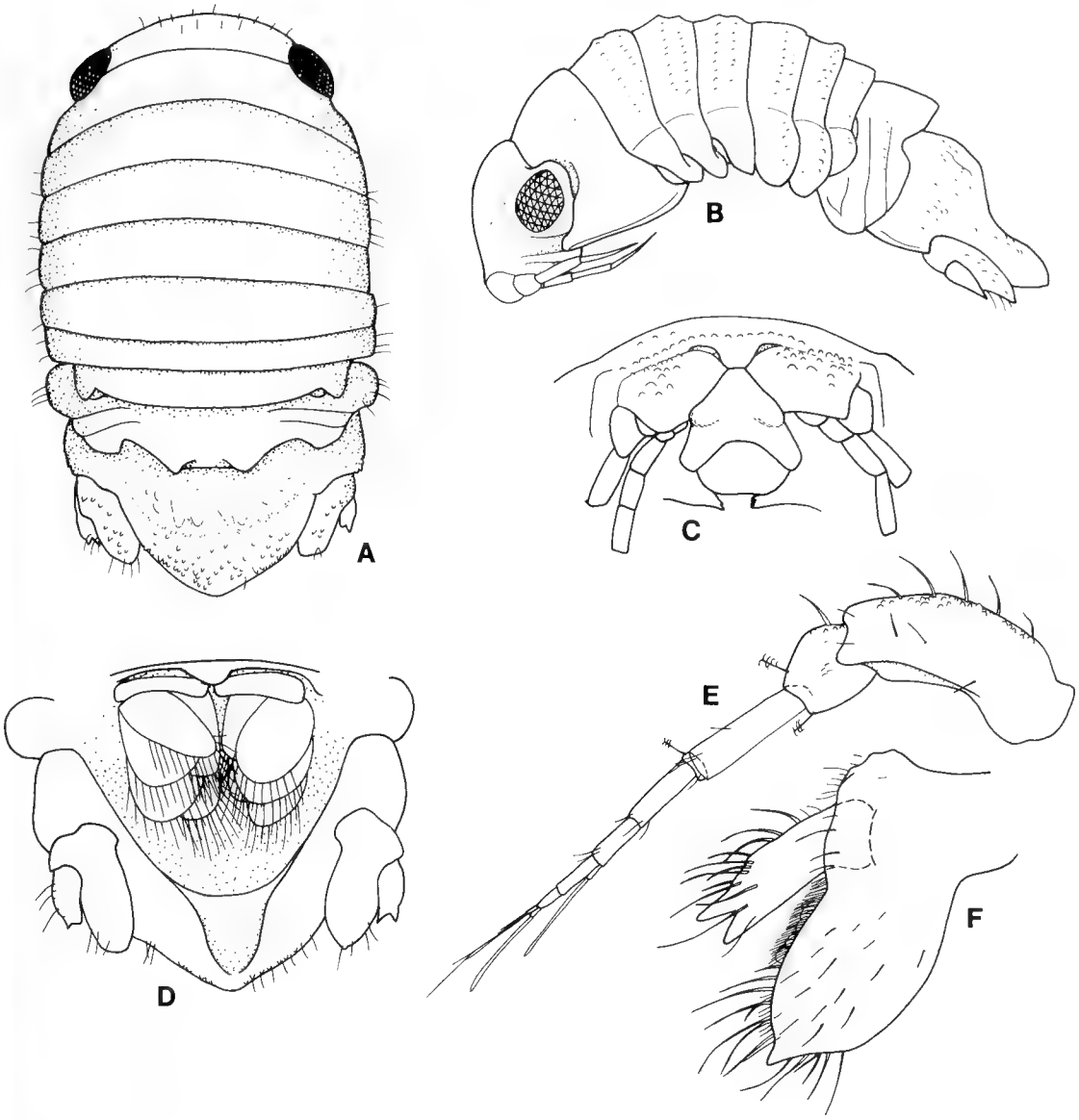


Figure 10. *Oxinasphaera bisubula* sp. nov. Non-ovigerous ♀ 4.3 mm (NMV J40490). A, dorsal view; B, lateral view; C, frons; D, pleon and pleotelson, ventral view; E, antennule; F, uropod. Scale 1.0 mm.

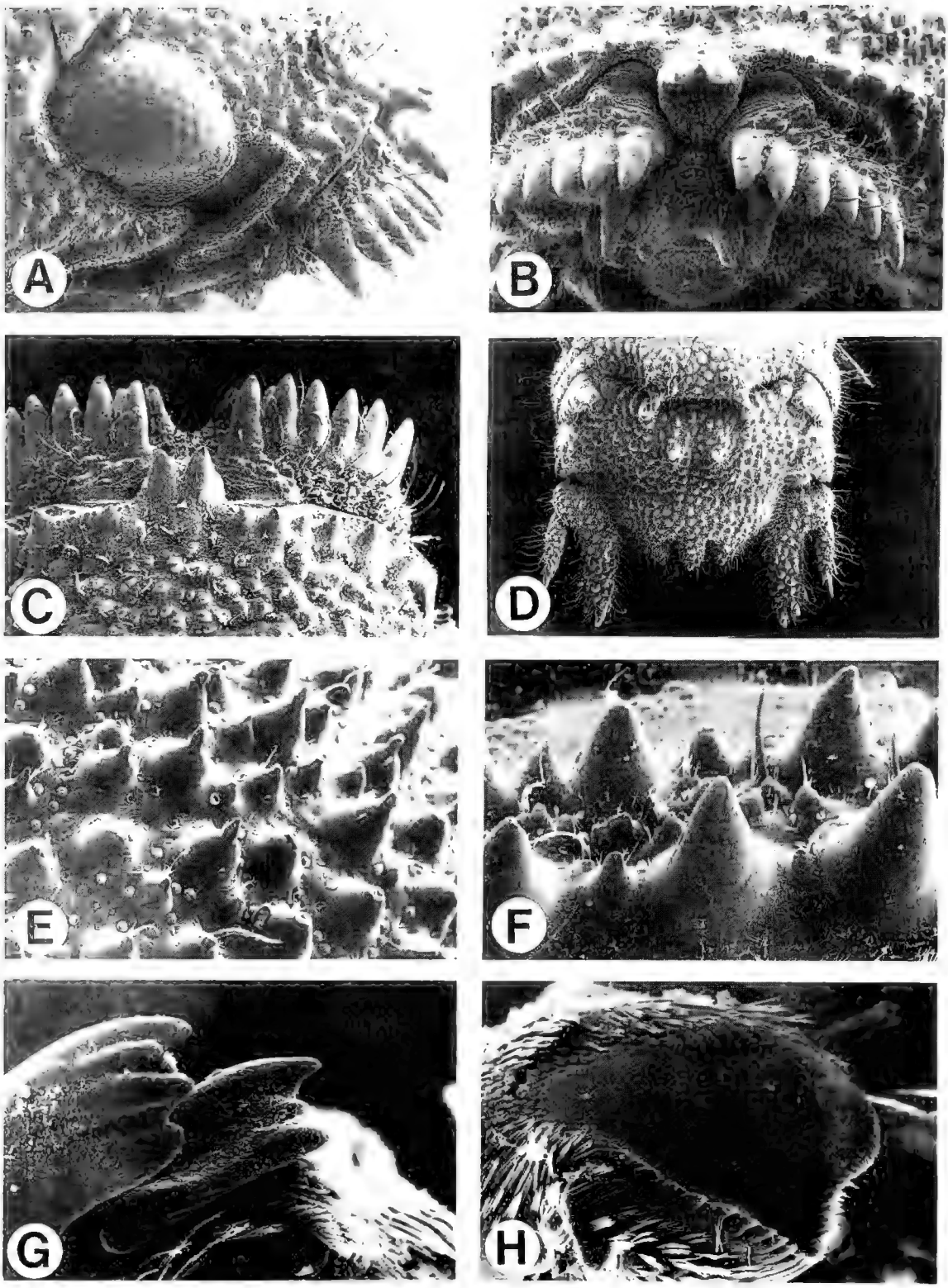


Figure 11. *Oxinasphaera bisubula* sp. nov., SEMs. A–F ♂ 4.8 mm, G, H ♂ 4.5 mm (NMV J40490). A, cephalon, lateral view (×100); B, cephalon anterior margin and frons (×110); C, cephalon, anterior margin (×110); D, pleon and pleotelson (×40); E, pleotelson tubercles (×270); F, spike rows, pereonite 5 (×370); G, left mandible, incisor, lacinia mobilis and spine row (×750); H, molar process (×700).

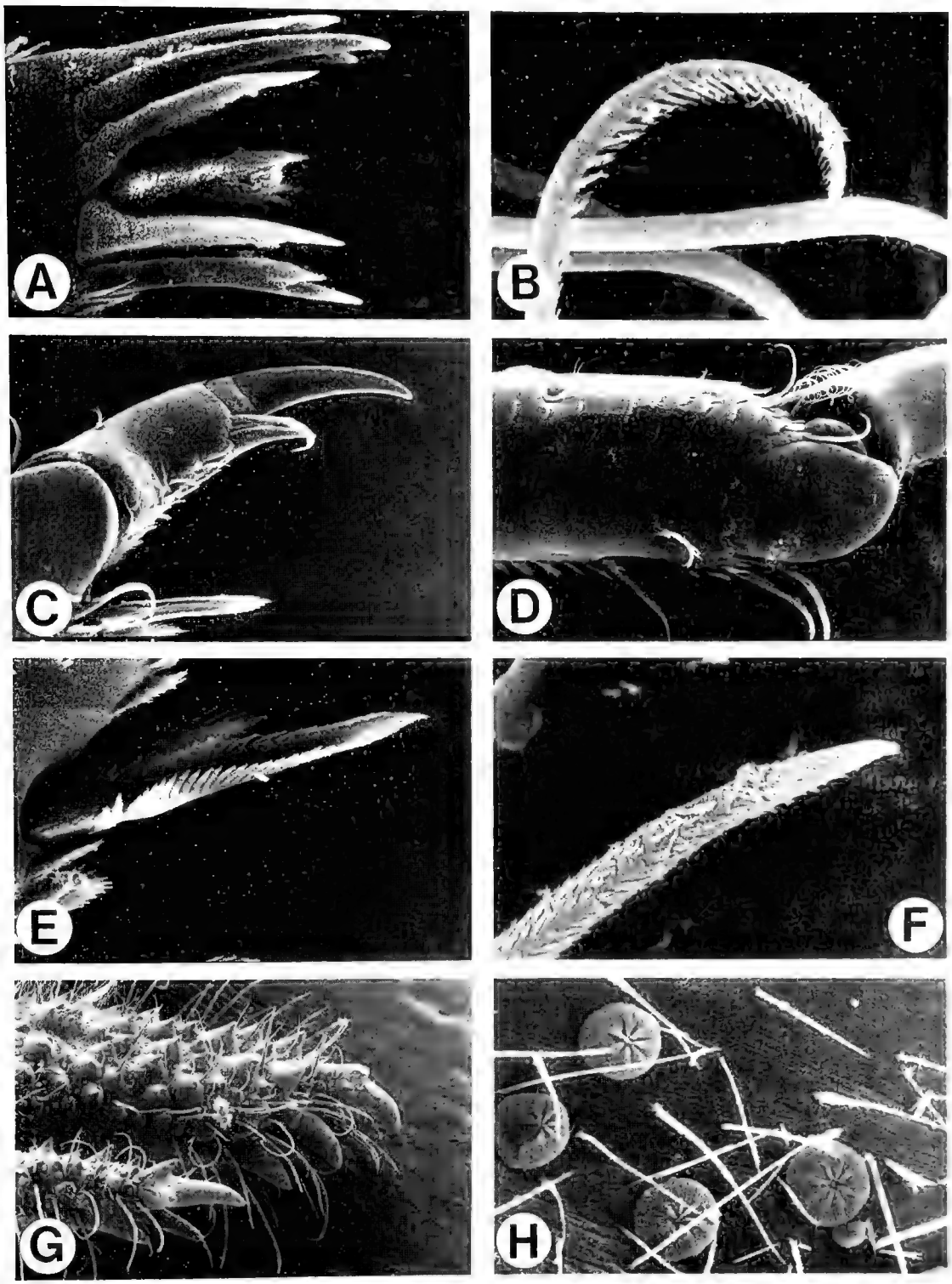


Figure 12. *Oxinasphaera bisubula* sp. nov., SEMs. All figs ♂ 4.5 mm (NMV J26267). A, maxillule, lateral lobe (×950); B, seta, maxilliped palp article 4 (×4000); C, pereopod 1, dactylus (×450); D, pereopod 2, propodus (×450); E, serrate spine, pereopod 1 propodus (×1200); F, seta from uropod (×2700); G, uropod rami, apices (×150); H, detail, pleotelson cuticle (×2000).

subtruncate apex; proximolateral margin with scale spikes.

Pleopod 1 exopod with c. 28 PMS, endopod with c. 19 PMS. Pleopod 2 exopod and endopod with c. 16 and 28 PMS respectively; appendix masculina straight, 6.0 times as long as maximum width, narrowing shortly before apex to sub acute point, extending beyond endopod slightly (by about 0.15 of its length). Pleopod 3 exopod and endopod with c. 14 and 26 PMS respectively. Pleopod 4 exopod with single seta at distomedial angle, endopod with 6 thickened fleshy ridges. Pleopod 5 exopod with 2 apical lateral scale lobes 1 medial apical scale lobe and one lateral proximal scale lobe, endopod with 7 thickened fleshy ridges. Uropod dorsally nodular, covered with roughened setae; exopod about 4.7 times as long as proximal width, about half as long as endopod, apex deeply bifid with lateral process prominent; endopod about 3.4 times as long as wide, apex with prominent terminal and 3 downwardly directed prominent spikes.

Ovigerous Female. Body dorsally without tubercles, with sparse setae; posterior margin of pleotelson with thickened rim, with shallow median indentation. Uropod rami thickened, covered with fine setae and longer thickened setae.

Non-ovigerous Female. Body dorsal surfaces with weak transverse tubercles on pereonites 2–7, pleon and pleotelson; pleon with 2 obvious low submedian mounds; pleotelson with 4 indistinct ridges, variable in development between individuals, never prominent.

Colour. Pale yellow ground colour, often with chromatophores which are more evident in females. Cuticle of preserved specimens may be clear or opaque.

Size. Males 3.3–5.1 mm, females 3.5–4.5 mm, ovigerous females 3.8–4.5 mm, mancas 0.9–2.8 mm.

Variation. In some localities, notably southern Tasmania, the males have the posterior pair of pleotelsonic tubercles less well developed than those of the type series.

Remarks. This species, restricted in its distribution to south-eastern Australia, is the most frequently collected member of the genus. Males are readily recognized by the prominent pleonal spikes, the presence of a second pair of pleotelsonic tubercles, a bifurcate spike on the rostrum, and the antennule peduncle article 1 with 6 or 7 spikes. Females of *Oxinasphaera bisubula* can be recognized by the submedian pair of domed mounds on the pleon, a feature shared with few other species either in the group or in the genus.

There are several other species similar to *Oxinasphaera bisubula*, and these are best separated using the key provided.

Distribution. Here recorded from off Moreton Bay, south-eastern Queensland (27°7′S), along the New South Wales coast to the Bass Strait and Tasmania (43°11′S) and westwards to Victoria (143°24′E), at depths from the intertidal to 130 m, with only one record at a depth greater than 77 m; of the samples where depth was recorded, about 71% are from less than 50 m. Twelve samples are recorded from sponges or have sponges mentioned in the habitat data.

Hosts. Sponges, including some identified as *Echinoclathria* sp., *Teichonella labrinthica* and *Polymastea craticia.*

Etymology. The epithet is derived from the Latin *subula* (= awl-shaped or pointed), and alludes to the prominent spikes on the epistome.

Oxinasphaera parodia sp. nov.

Figures 13, 14

Material examined. Holotype, ♂ (5.0 mm), S of point Hicks, Vic, 38°17.7′S, 149°11.3′E, 24 Jul 1986, 400 m, coarse sand, gravel, mud, many sponges, M.F. Gomon (NMV J40486).

Paratypes. 12♂ (3.5–4.8 mm, mean = 4.1 mm), 13 ♀ (ovig 4.0, 4.5 mm; 11 non-ovig 2.8–4.0 mm, mean = 3.5 mm), 31 mancas (1.6–2.3 mm), same data as holotype (NMV J19159 [♂], J19160 [♀ and mancas]).

Description of male. Body about twice as long as greatest width; dorsal surfaces not polished, generally granular, with scattered setae. Cephalon dorsal surface laterally finely nodulose; anterior margin with 3–4 small lateral tubercles on either side of rostrum; with prominent bifurcate spike on rostrum. Pereonite 1 without ornamentation. Pereonite 2 with 2 fine transverse rows of low spikes, pereonites 3–7 each with 2 transverse rows of prominent acute spikes, anterior row larger than posterior row; coxae 5 and 7 with posterior margins evenly rounded, coxa 6 posteriorly subtruncate. Pleon with posterior boss, with posterolateral angles of boss each with prominent posteriorly directed spikes. Pleotelson with 2 prominent spikes opposing those of pleon, dorsal surface heavily granular, without distinct tubercles; posterolateral flange with 1 submarginal and 2 marginal tubercles; posterior

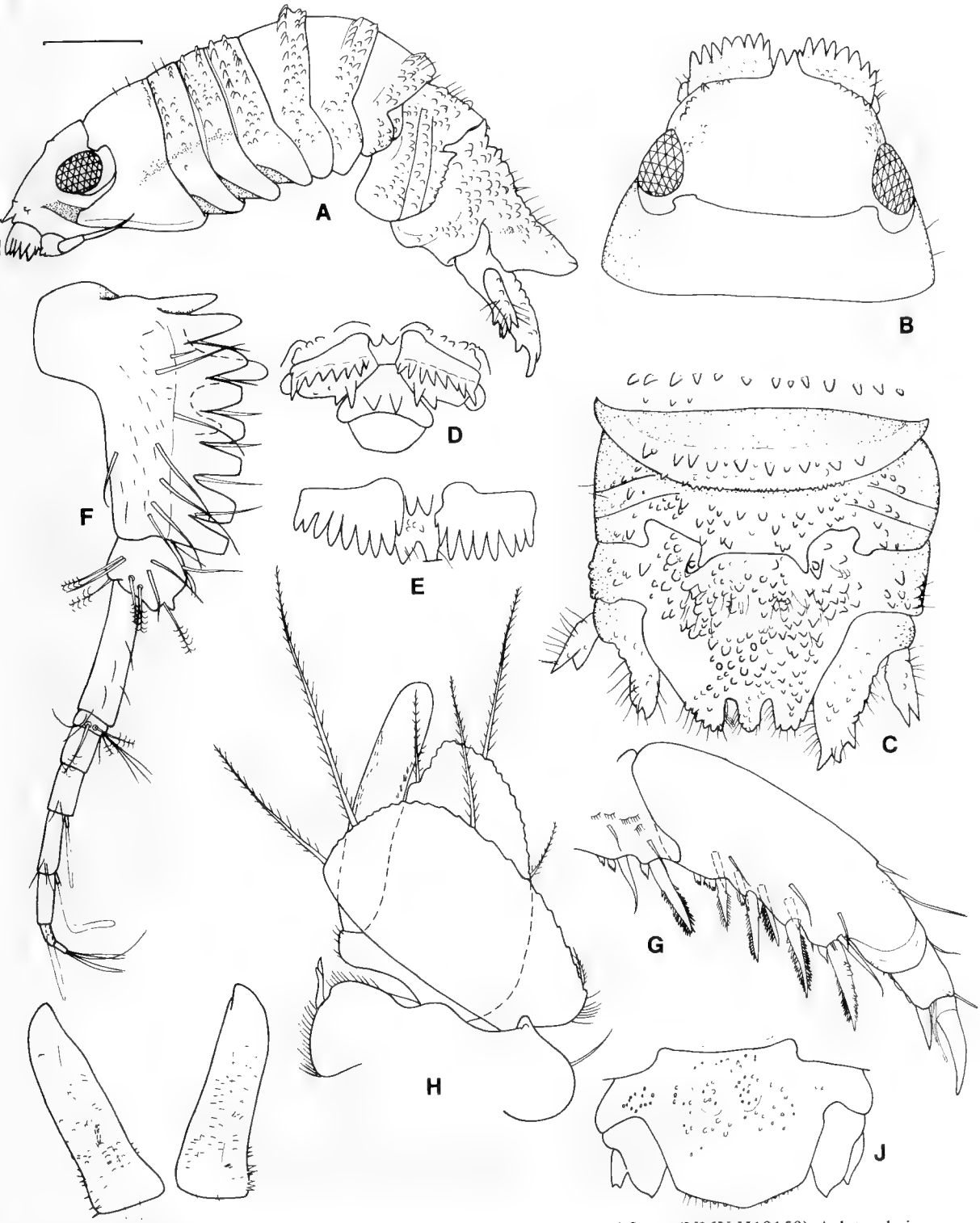


Figure 13. *Oxinasphaera parodia* sp. nov. A–E holotype, F–I paratype ♂ 4.8 mm (NMV JJ19159). A, lateral view; B, cephalon, dorsal view; C, pleon and pleotelson, dorsal view; D, frons; E, antennules, anterior view; F, antennule; G, pereopod 1 propodus; H, pleopod 2; I, penes; J, non-ovigerous ♀ 3.5 mm, pleon and pleotelson. Scale 1.0 mm.

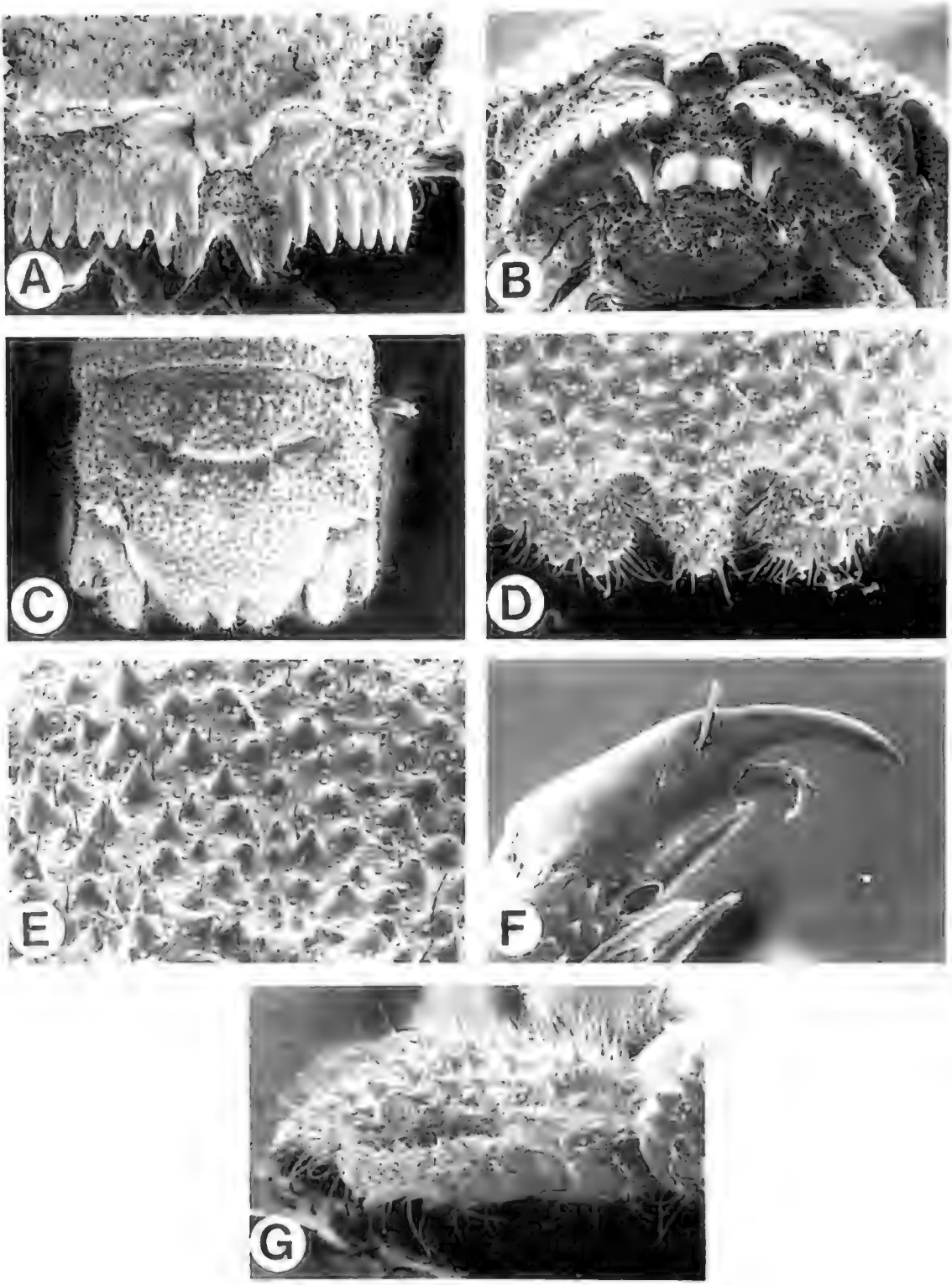


Figure 14. *Ovinasphaera parodia* sp. nov. SEMs. ♂ 4.2 mm (NMV J19159). A, cephalon, anterior view (×95); B, frons (×90); C, pleon and pleotelson (×77); D, pleotelson apex (×120); E, detail, pleotelson cuticle (×160); F, pereopod 1 dactylus, medial aspect (×400); G, uropod (×110).

margin with 2 submedian indentations on either side of median lobe.

Antennule peduncle article 1 with 8 anterior spikes; with 1 long proximo-posterior spike and 1 short posterior spike; article 2 with small spike at anterodistal margin; dorsal surface of peduncular articles 1 and 2 provided with numerous roughened setae; flagellum with 6 articles.

Epistome with 2 prominent widely separated conical spikes set on transverse ridge.

Pereopod 1 propodus about equal in length to ischium, widest proximally, about 2.7 times as long as wide, posterior margin with distinct scale spikes and 4 large biserrate spines, row of 4 smaller biserrate spines on medial margin; dactylus 0.5 length of propodus, unguis about 80% length of entire dactylus.

Penial processes each process about 3.0 times as long as basal width, tapering slightly, distolateral margin curving smoothly to meet medial margin; proximolateral margin with scale spikes.

Pleopod 2 appendix masculina straight, about as long as endopod, 5.2 times as long as maximum width, extending slightly beyond endopod (by about 0.18 of its length). Uropod exopod about 4.0 times as long as proximal width, about 0.4 times as long as endopod, apex deeply bifid with lateral process prominent; endopod about 4.0 times as long as wide, apex 3 prominent ventrally directed spikes.

Female. Ovigerous and non-ovigerous females could not reliably be distinguished from females of *O. bisubula* other than by lack of chromatophores, and lack of pleonal mounds.

Colour. White, chromatophores not apparent.

Size. Males 3.5–5.0 mm, females 2.8–4.4 mm, ovigerous females 3.8–4.5 mm, mancas 1.6–2.3 mm.

Remarks. This species is very similar to *Oxinasphaera bisubula*, but differs consistently in several male characters: antennule with 8–9 anterior spikes (versus 6–7); anterior cephalic margin only laterally nodulose, weakly so (versus entire anterior margin); pleotelson without posterior pair of prominent tubercles (versus with); pleotelson with prominent rough tubercles (versus tubercles not as prominent); appendix masculina blunt (versus with apically narrowed and obliquely truncate).

Females are virtually indistinguishable from *O. bisubula*, and without males probably cannot be identified with certainty. Both males and females are, in contrast to *O. bisubula*, without chromatophores.

Distribution. Known only from the type locality, off the eastern Victoria coast at a depth of 400 metres.

Hosts. Host identity not known.

Oxinasphaera lobivia sp. nov.

Figures 15, 16

Material examined. Holotype. ♂ (3.7 mm), S of Saint Helena Is., Moreton Bay, south-eastern Qld, 2 Sep 1979, 6 m, from trawled sponge, N.L. Bruce (QM W20034).

Paratypes. 12♂ (2.6–3.4 mm, 3.3 [dissected], mean = 3.1 mm), 13♀ (4 ovig 2.9–3.8 mm, mean = 3.3 mm; 7 non-ovig 2.1–2.9 mm, mean = 2.5 mm), same data as holotype (QM W20035, W20036, W20037, W20045, 2♂, 2♀ ZMUC CRU1387). 4♂ (2.8, 2.8, 2.9, 2.9, mm), 17♀ (4 ovig 3.0–3.3 mm, mean = 3.1 mm; 13 non-ovig 2.1–3.1 mm, mean = 2.6 mm), manca (1.8 mm), Shag Rock, Stradbroke Is., south-eastern Qld, 22 Aug 1979, in sponge, M. Ready and Niels Svennivig (QM W20041).

Non-paratypic material. **NSW.** 4♂ (3 damaged or poor), 15♀, W of Spit Bridge, Middle Harbour Port Jackson, 33°8.2′S, 151°14.6′E, 19 Jun 1981, 8 m, telestacean bed with mussels, J.K. Lowry (AM P41177); 2♂, non-ovig ♀, 2 mancas, Jibbon Point, Port Hacking, 34°05′S, 151°10′E, 13 Aug 1981, 15 m, sponge, J.K. Lowry and R.T. Springthorpe (AM P44208).

Description of male. Body about 2.2 times as long as greatest width; dorsal surfaces polished, finely pitted on cephalon and pereonite 1, otherwise generally granular, with scattered setae. Cephalon dorsal surface not nodulose; anterior margin with 7 small close set nodules on either side of rostrum; with prominent broad based bifurcate spike on rostrum. Pereonite 1 without tubercles or ornamentation. Pereonite 2 with 2 fine transverse rows of low spikes, pereonites 3–7 each with 2 transverse rows of prominent acute spikes, anterior row larger than posterior row; coxae 5 and 7 with posterior margins evenly rounded, coxa 6 ventro-posteriorly subtruncate. Pleon with posterior boss, with posterolateral angles of boss each with prominent posteriorly directed spikes, each with 2 tubercles anteriorly. Pleotelson with 2 prominent spikes opposing those of pleon, dorsal surface granular, with 2 tubercles set posterolaterally to each primary spike; posterolateral flange without prominent spikes; posterior margin with 2 submedian indentations on either side of median lobe.

Antennule peduncle article 1 with 7 anterior spikes, distalmost spike being distinctly smaller than remainder; with 1 long proximo-posterior

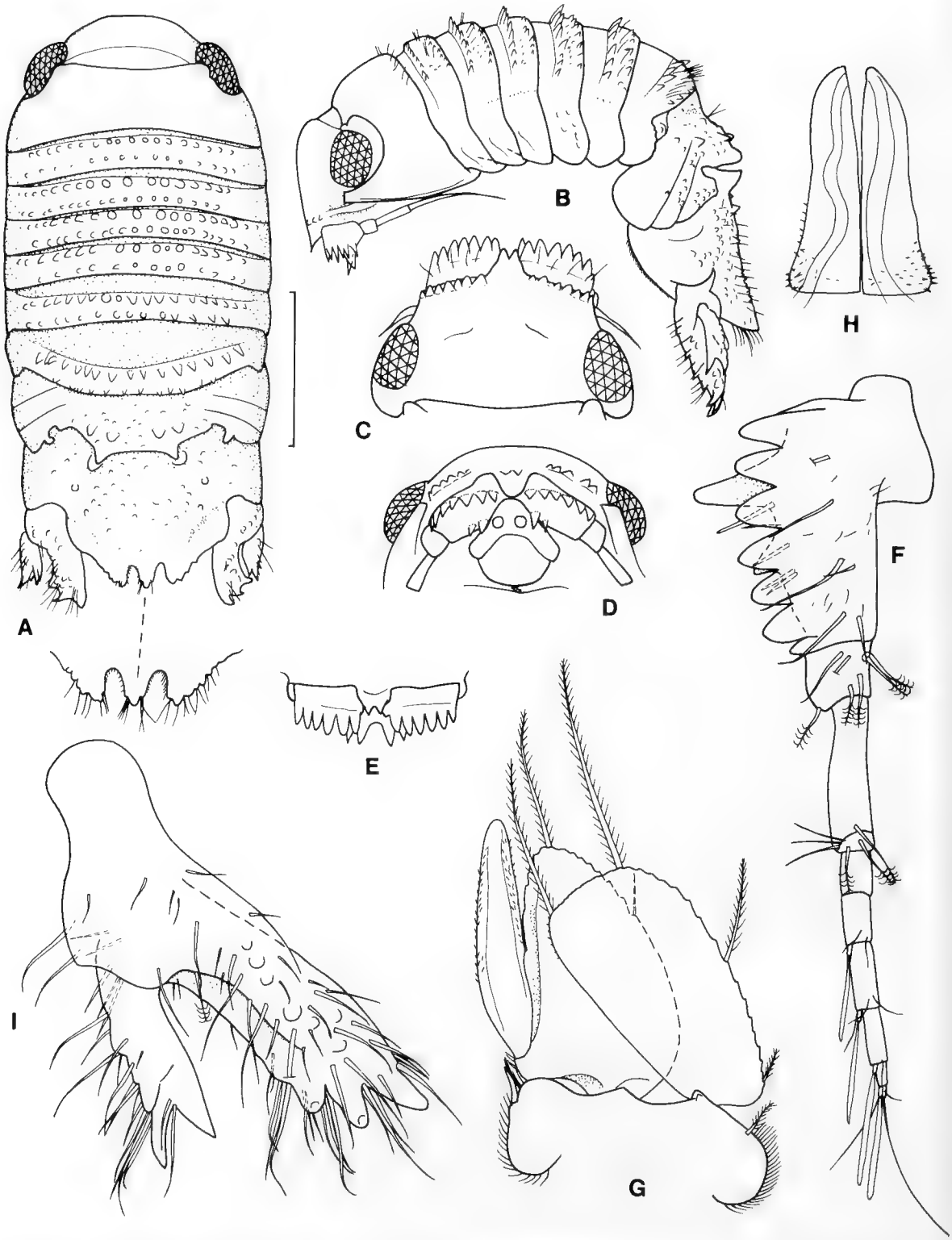


Figure 15. *Oxinasphaera lobivia* sp. nov. A-E holotype, F-I paratype ♂ 3.3 mm (QM W20045). A, dorsal view; B, lateral view; C, cephalon; D, frons; E, antennules, anterior view; F, antennule; G, pleopod 2; H, penes; I, uropod. Scale 1.0 mm.

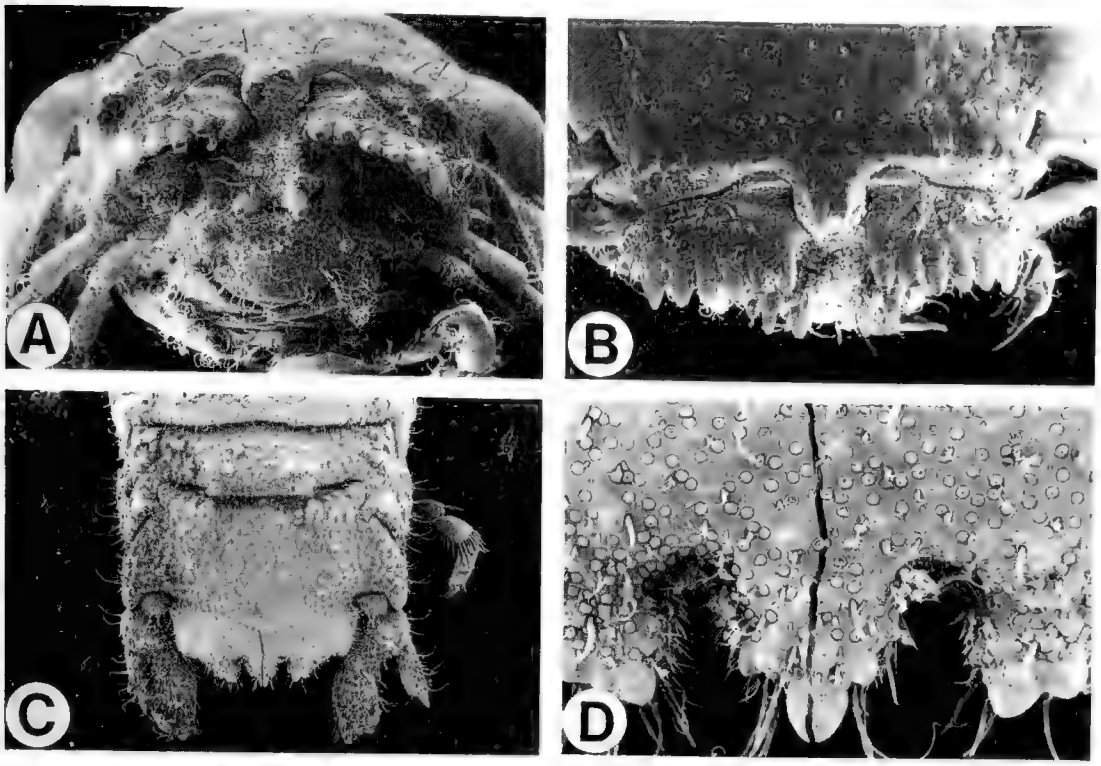


Figure 16. *Oxinasphaera lobivia* sp. nov. SEMs. ♂ 3.5 mm (QM W20037). A, cephalon, anterior view (×100); B, cephalon, anterior margin (×110); C, pleon and pleotelson (×45); D, pleotelson apex (×270).

spike and 1 short posterior spike; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae; flagellum with 6 articles.

Epistome with 2 prominent widely separated conical spikes.

Pereopods essentially the same as *O. bisubula*.

Penial processes each process about 3.2 times as long as basal width, tapering slightly, distolateral margin curving smoothly to meet medial margin; proximolateral margin with scale spikes.

Pleopod 2 appendix masculina straight, 4.8 times as long as maximum width, about as long (0.94) as endopod, extending slightly beyond endopod (by about 0.12 its length), apex narrowly rounded. Uropod exopod about 2.8 times as long as proximal width, about 0.4 times as long as endopod, apex deeply bifid with lateral process prominent; endopod about 3.5 times as long as wide, apex with 3 prominent ventrally directed spikes.

Female. Females are not distinguishable from those of *O. bisubula*.

Colour. Abundant dark brown and black chromatophores giving an overall dark brown appearance.

Size. Males 2.6–3.7 mm, females 2.1–3.1 mm, ovigerous females 2.9–3.8 mm, manca 1.8 mm.

Remarks. Oxinasphaera lobivia is distinguished from others of the *O. bisubula* group of species by the cephalic ornamentation, additional pair of pleonal tubercles and the two pairs of secondary pleotelsonic tubercles. The characters which distinguish this species are: cephalon anterior margin with 7+7 low spikes; antennule peduncle article 1 with 7 anterior spikes; pleon with 2 prominent nodules anterior to the posterior spikes; pleotelson with 2 pairs of tubercles set posterolaterally to the pleotelson spikes; rostrum with short bifurcate spike, basally wide; uropod wide distally with 3 prominent terminal spikes.

The presence of the posterior pairs of tubercles is not always easy to observe, but this and the additional pleonal spikes reliably separates this species from the type species.

Distribution. South-eastern Queensland (Moreton Bay and Stradbroke Is.), Sydney and Port Hacking, central NSW, all locations shallow inshore habitats.

Hosts. Collected from unidentified sponges.

Oxinasphaera frailea sp. nov

Figures 17–19

Material examined. Holotype. ♂ (3.9 mm), Table Head, Port Essington, Cobourg Peninsula, NT, 11°14.4′S, 132°10.8′E, 13 May 1983, 3 m, rock washings, N.L. Bruce (NTM Cr0011333).

Paratypes. **NT.** ♂ (3.8 mm), 2♀ (non-ovig 3.3, 3.5 mm), 3 mancas (2.7, 2.8, 3.0 mm), same data as holotype (NTM Cr0011334). ♂ (3.1 mm), same data as holotype but 14 May 1983, 3 m, algal covered rocks, N.L. Bruce and D. Staples (ZMUC CRU1384). 3♂ (3.2, 3.3 broken, 3.4 mm), ♀ (non-ovig 3.3 mm), Walford Point, Coral Bay, Port Essington, Cobourg Peninsula, 11°12.0′S, 132°03.0′E, 18 May 1983, 3–4 m, coral reef, N.L. Bruce (NTM Cr01335). ♂ (2.9 mm), Table Head, Port Essington, Cobourg Peninsula, 11°14.4′S, 132°10.8′E, 13 May 1983, 4 m, *Jaspis* sp., AJB stn CP/51/8–10, N.L. Bruce (QM W20038).

Non-paratypic material. **NT.** 3♂ (3.2, 3.2 broken, 3.4 mm), ♀ (non/ovig 2.9 mm), Fannie Bay, Darwin, 11°24.0′S, 130°48.0′E, 26 Oct 1982, 8 m, hydroids, J.K. Lowry (NMV J42643). ♂ (3.0 mm), Arafura Sea, NE of Cobourg Peninsula, NT, 11°09′S, 134°27′E, 21 Oct 1989, 30.2 m, BRR (QM W20043).

WA. ♂ (3.9 mm), North West Shelf, 19°29.9′S, 118°52.0′E, 24 Oct 1983, 37 m, bottom 85% sand, T. Ward (ZMUC CRU1385). ♂ (3.6 mm), near Point Murat, Bundegi Reef, Exmouth Gulf, 21°49′S, 113°11′E, 4 Jan 1984, 9 m, pink sponge on dead coral, J.K. Lowry (AM P44198).

Description of male. Body about 2.1 times as long as greatest width; dorsal surfaces not polished, generally granular, with scattered setae.

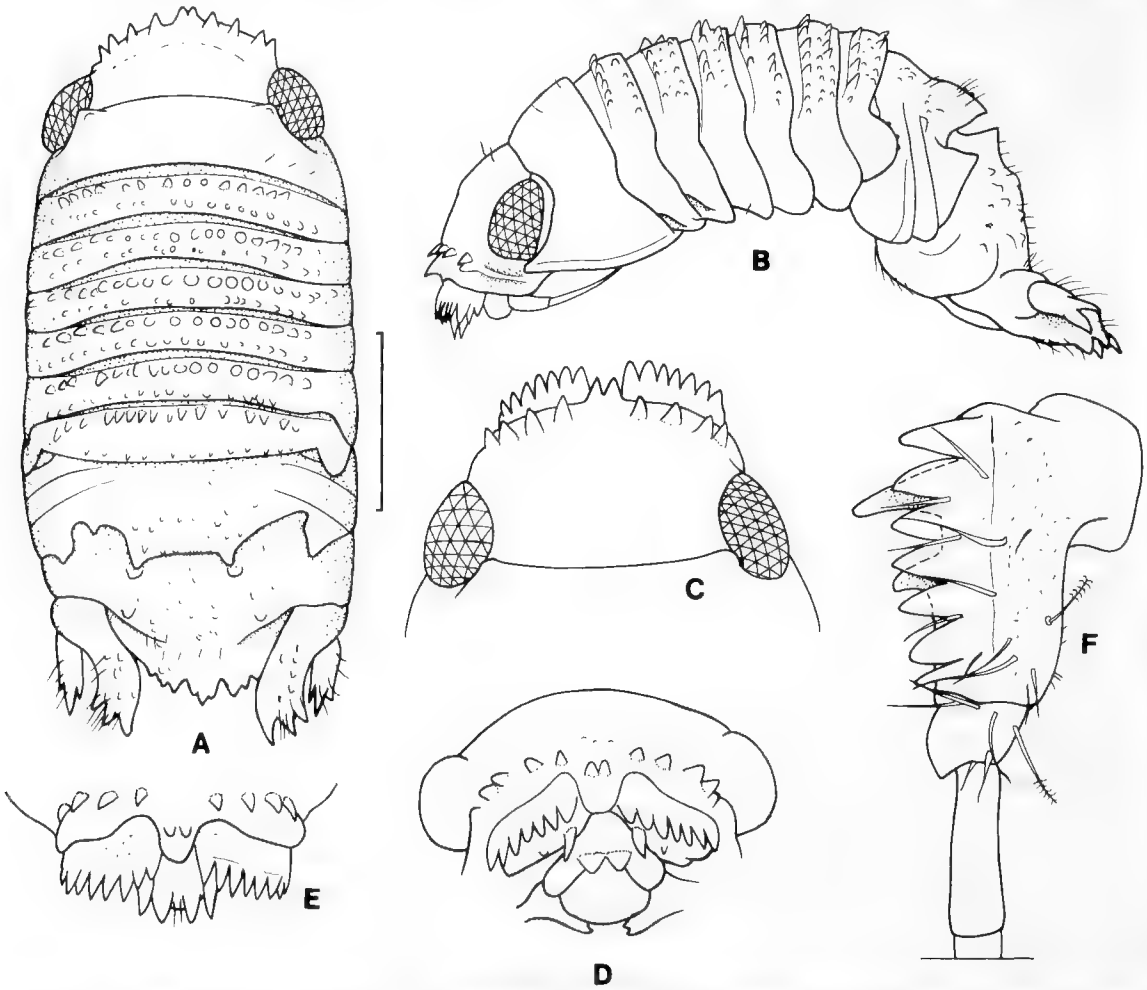


Figure 17. *Oxinasphaera frailea* sp. nov. F paratype ♂ 3.8 mm (NTM Cr0011334), remainder holotype. A, dorsal view; B, lateral view; C, cephalon; D, frons; E, antennules, anterior view; F, antennule. Scale 1.0 mm.

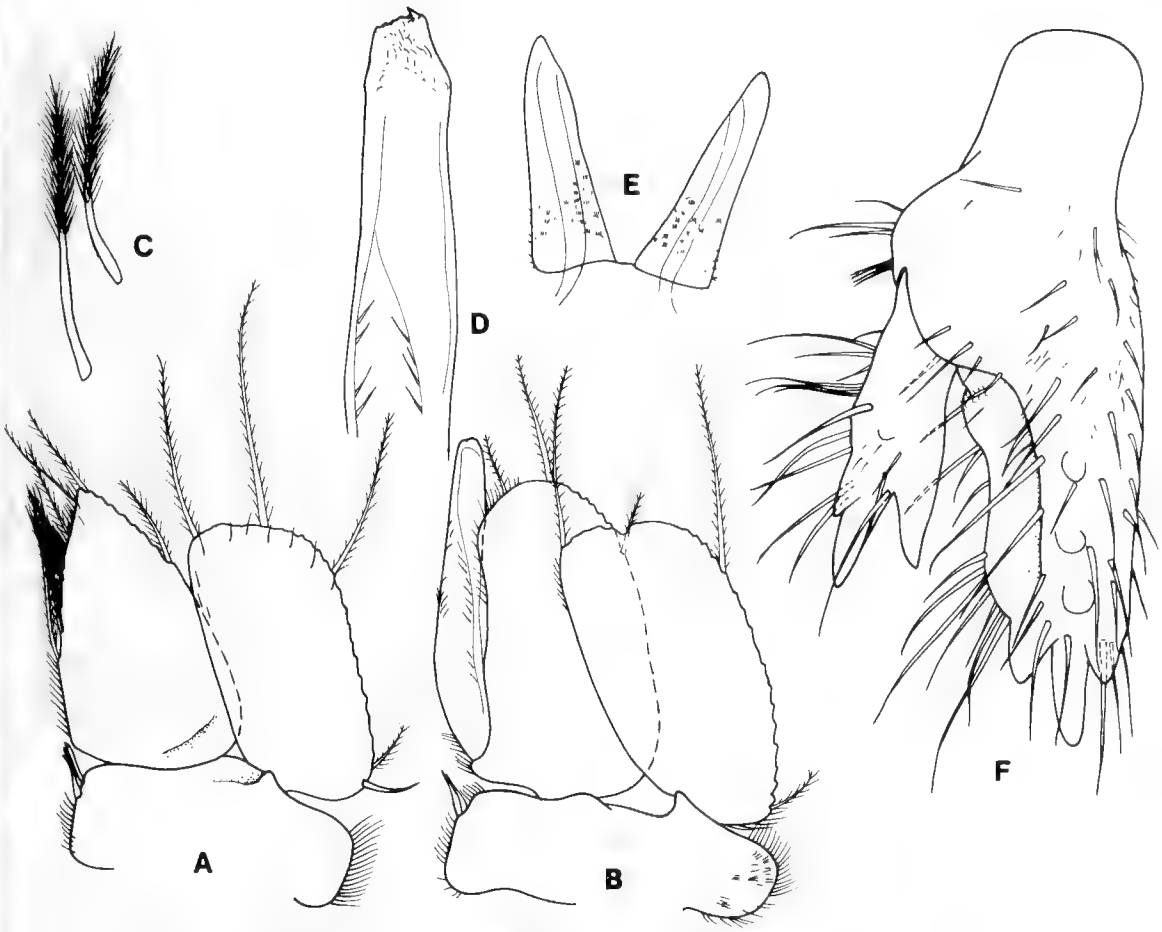


Figure 18. *Oxinasphaera frailea* sp. nov. F paratype ♂ 3.8 mm (NTM Cr0011334), remainder holotype. A, pleopod 1; B, pleopod 2: C, setae from distomedial margin of pleopod 1 endopod; D, apex, appendix masculina; E, penes; F, uropod.

Cephalon dorsal surface not nodulose; anterior margin with 4 prominent widely separated nodules on either side of rostrum; with prominent broad based bifurcate spike on rostrum. Pereonite 1 without tubercles or ornamentation. Pereonites 2 and 3 with 2 rows of distinct low rounded spikes, pereonites 4–7 each with 2 transverse rows of prominent acute spikes, anterior row larger than posterior row; coxae 5 and 7 with posterior margins evenly rounded, coxa 6 ventro-posteriorly weakly concave. Pleon with posterior boss, with posterolateral angles of boss each with prominent posteriorly directed spikes. Pleotelson with 2 prominent spikes opposing those of pleon, dorsal surface granular, with 1 tubercle set posterolaterally to each primary spike; posterolateral flange with 1 prominent tubercle; posterior margin with 2 submedian indentations on either side of median lobe.

Antennule peduncle article 1 with 7 anterior spikes; with 1 long proximo-posterior spike and 1 short posterior spike; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae.

Epistome with 2 prominent narrowly separated conical spikes, basally somewhat flattened.

Pereopods essentially the same as *O. bisubula*.

Penial processes each process about 2.7 times as long as basal width, tapering slightly, distolateral margin curving smoothly to meet medial margin, mediodistally margin weakly oblique; proximolateral margin with scale spikes.

Pleopod 1 endopod distally acute, distal half of lateral margin with conspicuously stout circumplumose setae, subapically without MS, with setulose patch. Pleopod 2 appendix masculina straight, 6.5 times as long as maximum

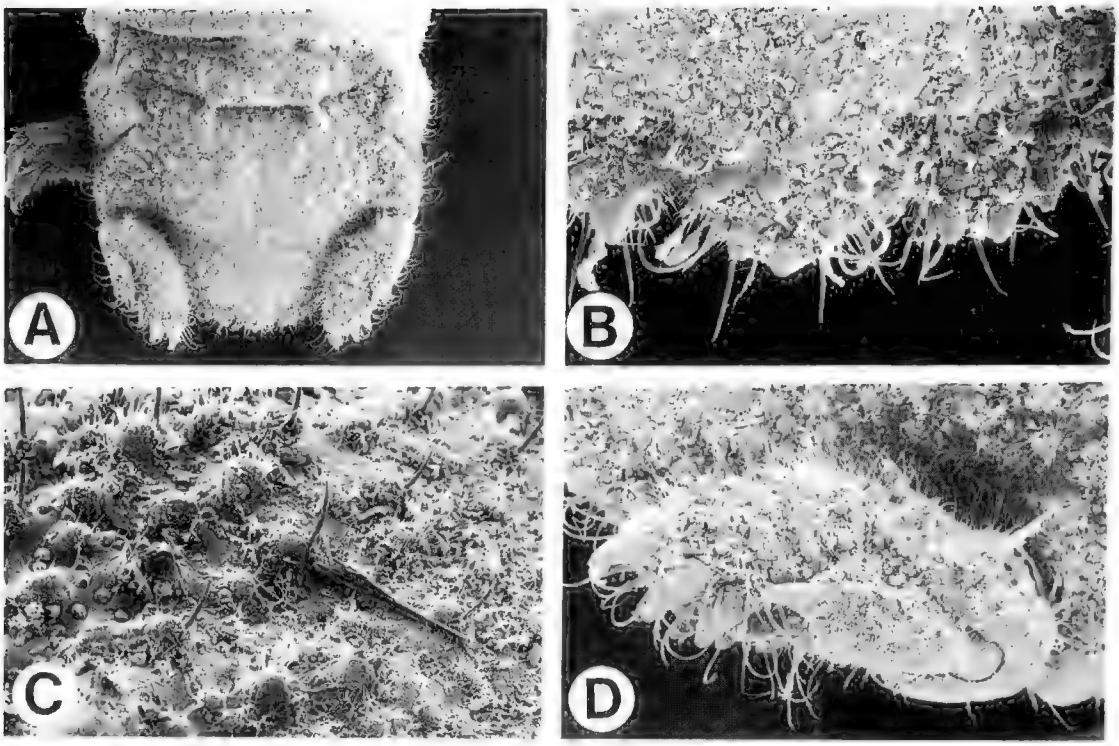


Figure 19. *Oxinasphaera frailea* sp. nov. SEMs. ♂ 3.3 mm (NTM Cr0011334). A, pleon and pleotelson (×55); B, pleotelson apex (×300); C, dorsal cuticle, pleotelson (×330); D, uropod (×180).

width, about as long as endopod, extending slightly beyond endopod (by about 0.13 of its length); apex subtruncate, distally irregular; endopod margins subparallel, distal margin broadly rounded. Uropod exopod about 3.1 times as long as proximal width, about 0.4 times as long as endopod, apex deeply bifid with lateral process prominent and additional lateral spike; endopod about 2.9 times as long as wide, apex 3 prominent spikes.

Female. Females are not distinguishable from others of this group.

Colour. Abundant dark brown and black chromatophores giving an overall dark brown appearance.

Size. Males 3.0–3.9 mm, females 2.9–3.5 mm, ovigerous females not observed, manca 2.7–3.0 mm.

Remarks. While the overall appearance of *Oxinasphaera frailea* is similar to that of others of the *O. bisubula* group, particularly the details of the pleon and pleotelson, there are several characters by which the species can be immediately recognized. The most obvious of these being the prominent acute tubercles on the anterior margin of the cephalon. The setation of pleopod 1, shape of the endopods of pleopods 1 and 2, and shape of the appendix masculina are unique within the genus.

The characters by which the species can be separated from others of the group are: cephalon anterior margin with 4+4 prominent widely spaced acute tubercles; antennule peduncle article 1 with 7 anterior spikes; pleon without tubercles anterior setae; pleopod 2 appendix masculina apically truncate, endopod broadly rounded.

Distribution. Tropical western and northern Australia from Exmouth Gulf, WA to Darwin and Cobourg Peninsula, NT, at depths between 3 and 37 m. All records are from inshore waters except that from the North West Shelf; apparently absent from coral reefs.

Hosts. Jaspis sp., one other record directly from an unidentified sponge.

Oxinasphaera denmoza sp. nov.

Figures 20, 21

Material examined. Holotype. ♂ (4.2 mm), Blue Lagoon, Lizard Is., Great Barrier Reef, Qld, 7 Jun 1987, c. 10 m, in red sponge, isolated patch reef near

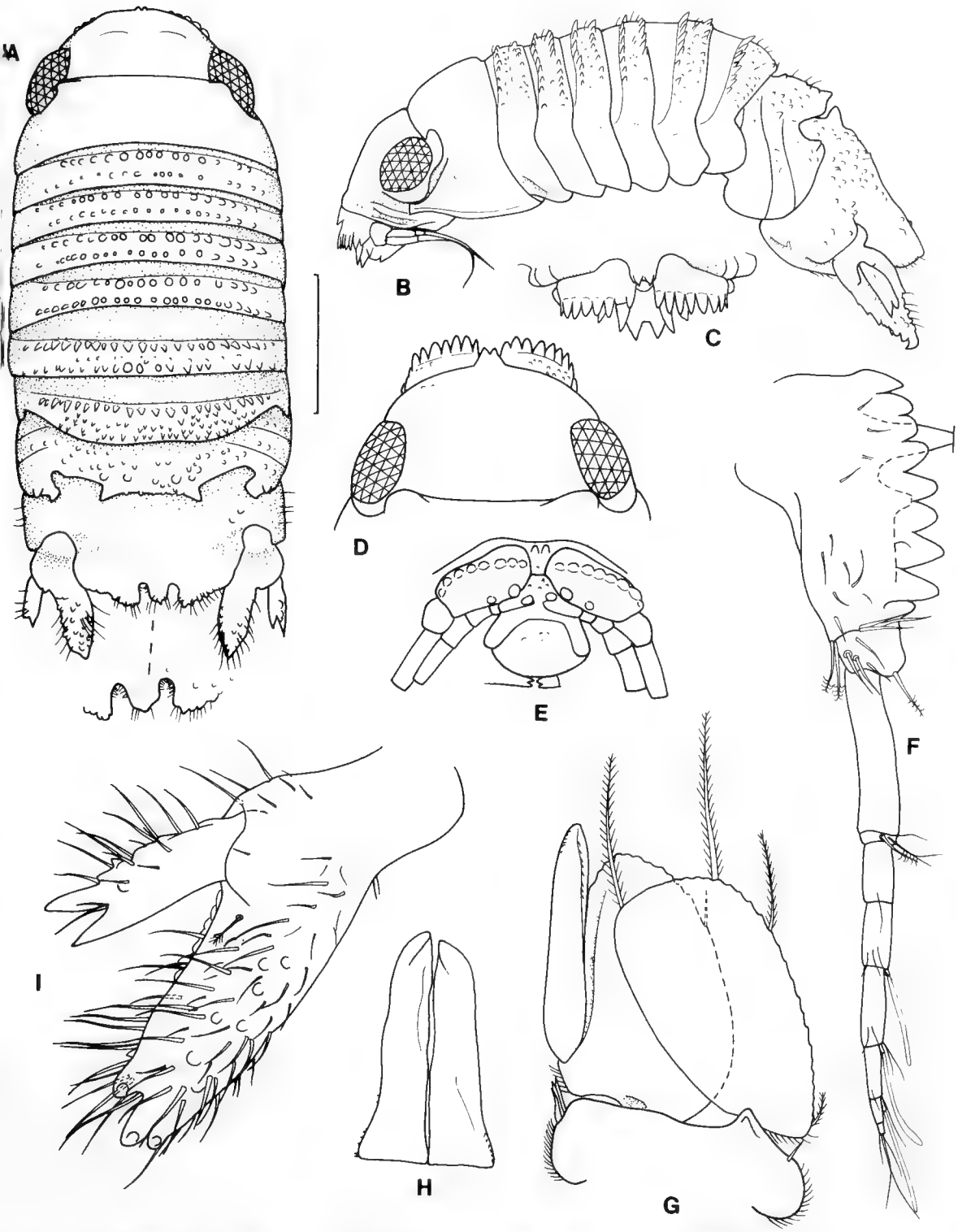


Figure 20. *Oxinasphaera denmoza* sp. nov. A–E holotype, F–H paratype ♂ 3.8 mm (QM W14949). A, dorsal view; B, lateral view; C, antennules, anterior view; D, cephalon; E, frons; F, antennule; G, pleopod 2; H, penes; I, uropod. Scale 1.0 mm.

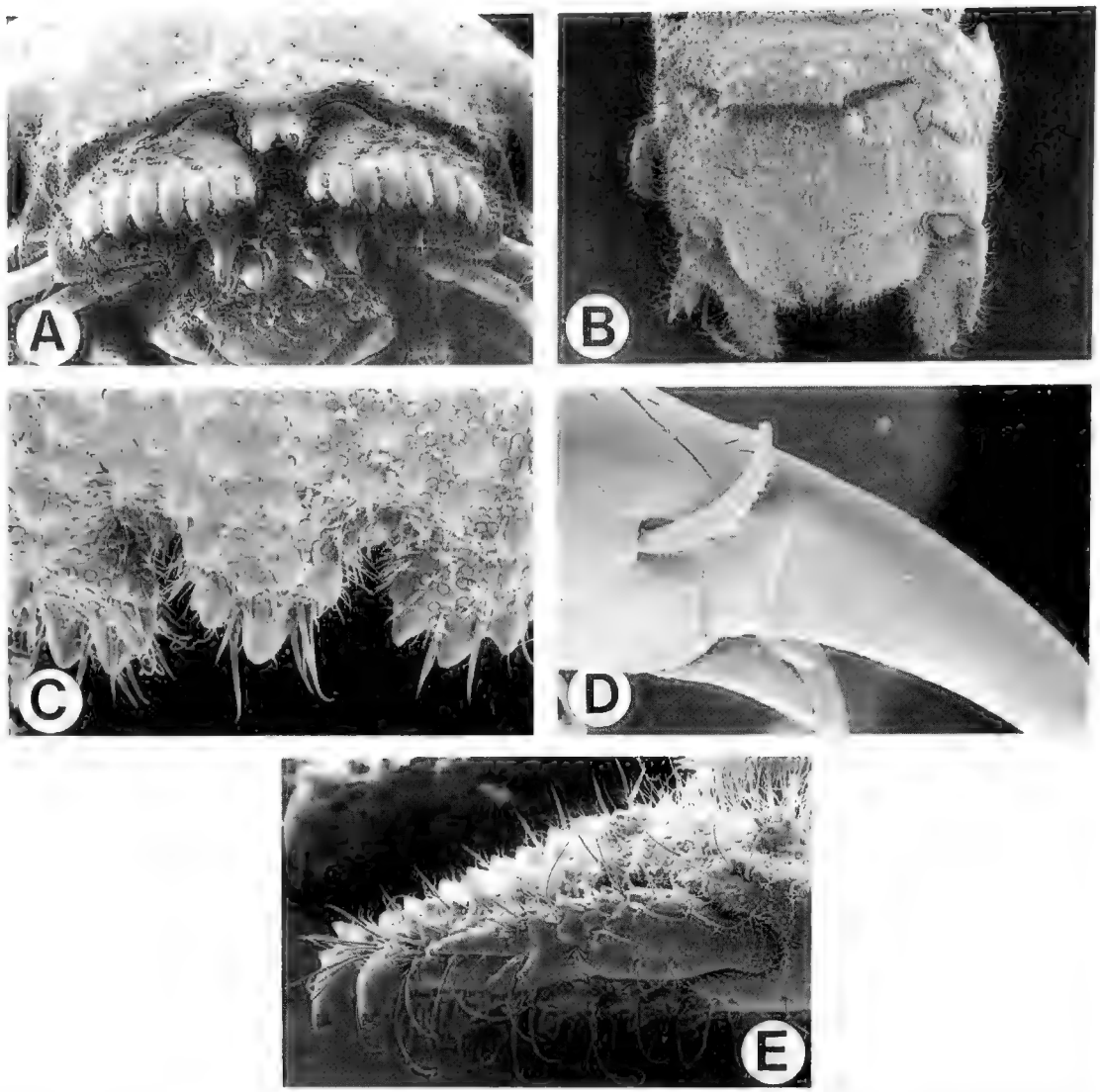


Figure 21. *Oxinasphaera denmoza* sp. nov. SEMs. ♂ 3.8 mm (QM W14949). A, cephalon, frontal view (×110); B, pleon and pleotelson (×50); C, pleotelson apex (×300); D, pereopod dactylus unguis, showing single distal seta (×1600); E, uropod, lateral view (×180).

lagoon entrance, P.J.F. Davie and J. Short (QM W20039).

Paratypes. **Qld.** 4♂ (3.7, 3.8, 3.8, 4.0 mm), same data as holotype (QM W14949). ♂ (3.3 mm), ♀ (ovig 3.2 mm), Watsons Bay, Lizards Is., 5 Jun 1987, 10–13 m, in sponge on sand/mud, P.J.F. Davie and J. Short (QM W14953). 6♂ (3.2, 3.3, .34, 3.5, 3.6, 3.6 mm), Watsons Bay, Lizard Is., 14°40′S, 145°28′E, 5 Dec 1975, 12 m, sandy bottom, W. Ponder, P. Colman and I. Loch (AM P41134).

Non-paratypic material. **Qld.** 4♂, 2♀, 70–80 immature, in poor condition, Mrs Watsons Beach, Lizard Is., 14°40′S, 145°28′E, 24 Nov 1978, 18.3 m, in sponge on sand, D.F. Hoese and H. Larson (AM P28849). 6♂, Wistari Reef, Capricorn Group, southern Great Barrier Reef, 16 Dec 1978, in sponge, 24 m, D. Fisk (QM W8060, 1 ♂ ZMUC CRU1381).

Description of male. Body about 2.3 times as long as greatest width; dorsal surfaces not polished, generally granular, with scattered setae. Cephalon dorsal surface not nodulose; anterior margin without nodules; with prominent broad based short bifurcate spike on rostrum. Pereonite 1 without tubercles or ornamentation. Pereonite 2 with 2 fine transverse rows of low spikes, pereonites 3–6 each with 2 transverse rows of prominent acute spikes, anterior row larger than posterior row; pereonite 7 without posterior row of spikes, covered with small pos-

teriorly directed acute tubercles; coxae 5 and 7 with posterior margins evenly rounded, coxa 6 ventro-posteriorly concave. Pleon with posterior boss, with posterolateral angles of boss each with prominent posteriorly directed spikes. Pleotelson with 2 prominent spikes opposing those of pleon, dorsal surface granular, without additional; posterolateral flange without 1 acute tubercle; posterior margin with 2 submedian indentations on either side of median lobe.

Antennule peduncle article 1 with 9 anterior spikes, distalmost spike being distinctly smaller than remainder; with 1 long proximo-posterior spike and 1 very short posterior spike; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae; flagellum with 6 articles.

Epistome with 2 prominent conical spikes, basally somewhat flattened, on basal transverse ridge.

Pereopods essentially the same as *O. bisubula*.

Penial processes each process about 3.5 times as long as basal width, tapering slightly, distolateral margin curving smoothly apex, medial margin straight; proximolateral margin with scale spikes.

Pleopod 2 appendix masculina straight, 6.2 times as long as maximum width, about as long (0.92) as endopod, extending slightly beyond endopod (by about 0.14 of its length), apex narrowly rounded. Uropod exopod about 3.4 times as long as proximal width, about 0.4 times as long as endopod, apex deeply bifid with lateral process prominent; endopod about 3.0 times as long as wide, apex with 3 prominent ventrally directed spikes.

Female. Females are not distinguishable from those of *O. lobivia* or *O. frailea* .

Colour. Dark brown and black chromatophores giving an overall brown appearance.

Size. Males 3.2–4.2 mm, ovigerous female 3.2 mm.

Remarks. The lack of any tubercles on the anterior margin of the cephalon and the number of antennular spikes (9) distinguishes *O. denmoza* from others of the *O. bisubula* group.

The characters by which this species can be identified are: cephalon anterior margin without tubercles; antennule peduncle article 1 with 9 anterior spikes; pleon without anterior tubercles; pleotelson without tubercles; rostrum with bifurcate basally flattened spike; uropod exopod distally narrow.

Distribution. Great Barrier Reef, Queensland, Wistari Reef, Capricorn Group, in the south and Lizard Island in the north; from the coral reef itself, at depths from 10 to 24 m.

Hosts. From unidentified sponges; only one sample was not recorded as having been collected directly from a sponge.

Oxinasphaera copiapoa sp. nov.

Figures 22, 23

Material examined. Holotype. ♂ (4.4 mm), off Moona Moona Creek, Jervis Bay, NSW, 35°03′S, 150°41′E, 19 Jun 1982, 3 m, from sponges, J.K. Lowry (AM P44207).

Paratypes. **NSW.** 11♂ (3.2–4.5 [dissected] mm, mean = 3.6 mm), 2♀ (non-ovig 4.1, 5.2 mm), 2 immature (3.2, 3.5 mm), same data as holotype (AM P41165, slide P44213; 2♂ and ♀ ZMUC CRU1380). ♂ (3.4, squashed 4.6 mm), ♀ (non-ovig 6.2 mm), off Moona Moona Creek, Jervis Bay, 35°03′S, 150°41′E, 15 Aug 1981, 5 m, from kelp holdfasts, P.B. Berents (AM P41182).

Non-paratypic material. **NSW.** ♂ (5.2 mm), ♀ (non-ovig 4.2 mm), inside Box Head, Broken Bay, 33°33′S, 151°21′E, 22 Nov 1982, sponge *Echinoclathria*, J.K. Lowry and R. T. Springthorpe (AM P44195). ♂ (3.5, squashed), 2 imm/♀ (1.9, 2.0 mm), off Moona Moona Creek, Jervis Bay, 35°03.5′S, 150°41.0′E, 15 Aug 1981, 4.5 m, on test of solitary ascidian *Herdmania momus*, P.B. Berents (AM P41200).

Description of male. Body about 2.4 times as long as greatest width; lateral margins subparallel. Cephalon anterior margin without tubercles; rostrum with weak trifurcate spike. Pereonite 1 unornamented. Pereonites 2–7 each with 2 transverse rows of spikes, anterior row distinctly larger than posterior row; coxae 5 posteriorly subtruncate, coxae 6 indented, coxae 7 rounded. Pleon with weak posterior boss, with 2 rounded tubercles at lateral angles of boss with 2 prominent tubercles set anterior to these, posterolateral margin of pleon with 3–4 with tubercles. Pleotelson granular, with spikes opposing pleonal spikes, 2 prominent tubercles set laterally and posteriorly on each side; posterolateral flange with 3 marginal rounded tubercles; posterior margin flattened, somewhat produced, with two submedian triangular excisions.

Antennule peduncle article 1 with 7 anterior spikes; with 1 long posteroproximal and 1 posteromedial spike; dorsal surface of peduncular articles 1 and 2 with few setae; flagellum with 5 articles.

Epistome with 2 basally separated distinct spikes; posterolateral lobes each with 2 distinct spikes.

Figure 22. *Oxinasphaera copiapoa* sp. nov. A–F holotype, F–I paratype ♂ 4.5 mm (AM P41165). A, dorsal view; B, lateral view; C, cephalon, anterior margin, ; D, antennules, anterior view and frons; E, pleotelson posterior margin; F, pleotelson posterior margin, ventral view; G, antennule; H, pereopod 1; I, pereopod 2; J, pereopod 7; K, penes. Scale 1.0 mm.

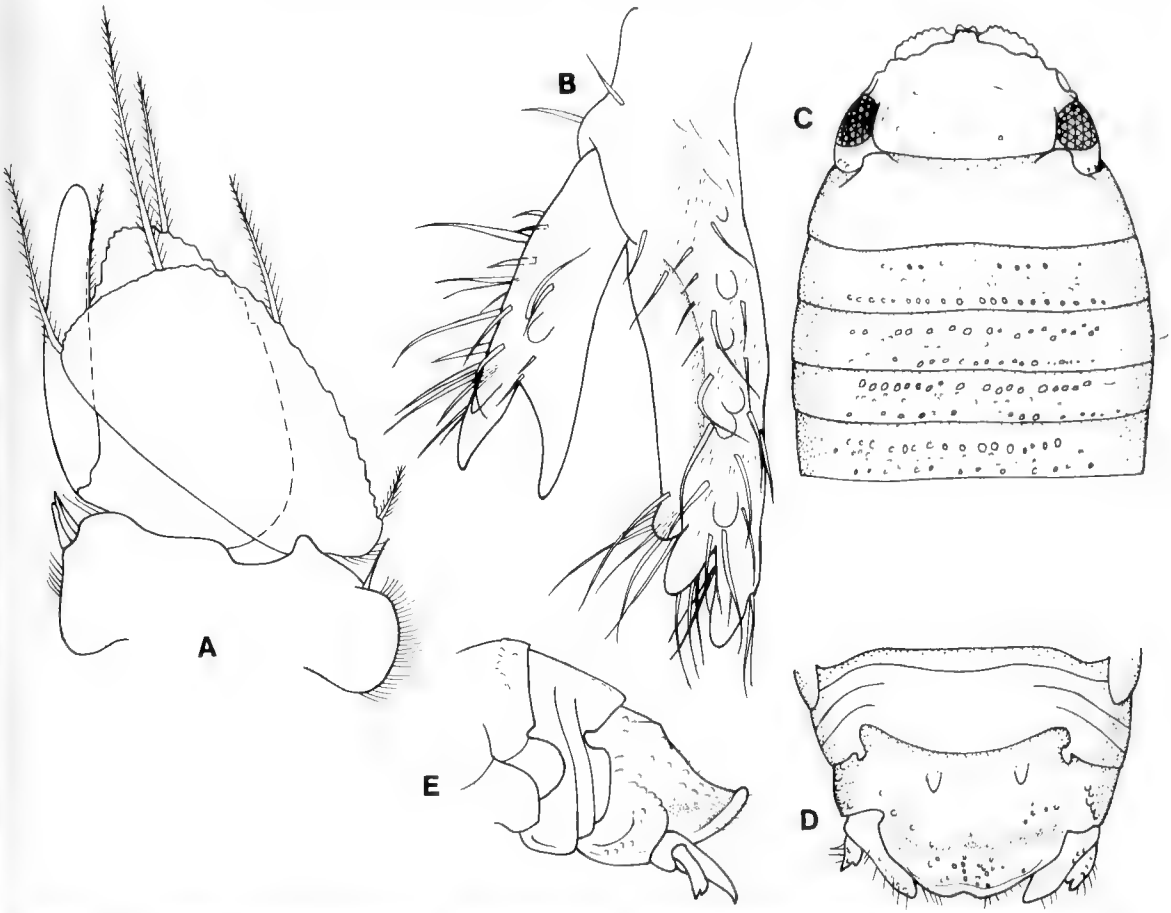


Figure 23. *Oxinasphaera copiapoa* sp. nov. A, B paratype ♂ 4.5 mm, C-E non-ovigerous ♀ 5.2 mm (AM P41165). A, pleopod 2; B, uropod; C, female, dorsal view; D, female, pleon and pleotelson, dorsal view; E, female, pleon and pleotelson, lateral view. Scale 1.0 mm.

Pereopod 1 basis about 2.4 times as long as wide, anterior margin with 2 sensory setae, distally scaled; ischium 0.7 times as long as basis, twice times as long as wide, anterior margin with 1 proximal spine and 1 distal longer feebly biserrate spine; merus 0.4 as long as ischium, 0.8 times as long as wide, anterolateral angle with 1 long and 1 short gently curving weakly pectinate spines, posterior margin with 1 biserrate spine and single long simple seta; carpus 1.2 times as long as long as merus, 1.3 times as long as wide, posterior margin with 2 biserrate spines third submarginal small biserrate spine and 2 simple setae; propodus slightly shorter (0.89) than ischium, widest proximally, about twice as long as wide, posterior margin with distinct scale spikes and 3 large biserrate spines, row of 4 smaller biserrate spines on medial margin; dactylus 0.6 length of propodus, unguis about 55% length of entire dactylus. Pereopod 2 similar others of genus. Pereopod 7 basis 2.7 times as long as wide, anterior margin with 7 sensory setae, and elongate scale setules; ischium slightly shorter (0.88) than basis, 3.0 times as long as wide; merus 0.4 times as long as ischium, 1.4 times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 1 large and 1 small spine; carpus about as long as merus, 1.8 times as long as wide, posterior margin with 3 biserrate, 2 simple and 1 trifid spines, distal margin with 2 large trifid spines and 5 biserrate spines; anterodistal angle with 2 slender weakly biserrate spines; propodus 1.2 times as long as carpus and 0.6 time as long as ischium, about three times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 2 sensory setae.

Penial processes about 3 times as long as basal width, apex narrowly rounded; proximolateral margin with scale spikes.

Pleopod 2 appendix masculina slightly shorter (0.96) than endopod, 6.9 times as long as

maximum width, extending beyond endopod by 0.14 of its length, very slightly curved laterally, apex bluntly rounded. Uropod dorsally nodular, covered with roughened setae; exopod about 4 times as long as proximal width, about half as long as endopod, apex deeply bifid with processes about equally prominent, ventral margin with 2 prominent acute serrations; endopod about 4 times as long as wide, apex with 3 prominent bluntly rounded spikes, ventral margin with 4–5 prominent bluntly rounded spikes.

Female. Pereonites 2–7 granular, with small tubercles. Rostrum trifid. Pleotelson with 2 indistinct low submedian bumps anteriorly; posterior margin with weak median indentation.

Colour. Pale tan in alcohol; chromatophores not observed.

Size. Males 3.2–4.5 mm, females 4.1–6.2 mm.

Remarks. Oxinasphaera copiapoa can be recognized by the posterior margin of the pleotelson being somewhat flattened and produced, the pleon having a weakly produced medial portion, the epistome with 2 discrete spikes, prominently bifid uropod apices and the anterior margin of the cephalon without submedian tubercles. *O. australis* can be separated by the three prominent tubercles on the anterior margin of the cephalon and the acute apex to the appendix masculina. *O. matucana* has two prominent tubercles on the anterior margin of pereonite 1, and the posterior antennule spikes are set wide apart with one at the distal extremity of peduncle article 1.

The male specimen from Broken Bay, possibly senescent, differs from the type material in lacking distinct tubercles on the median pleonal process. The specimens, other than being larger, agrees well with the type material.

Distribution. Sydney region to Jervis Bay, New South Wales, depths between 3 and 5 m.

Hosts. Ecinoclathria sp., and the ascidian *Herdmania momus*, possibly an accidental association

Oxinasphaera multidens
(Richardson, 1910) comb. nov.

Figure 24

Cymodoce multidens Richardson, 1910: 27, fig. 26.

Non *Cymodoce multidens*. — Kensley, 1984: 216 (= *O. kensleyi* sp. nov.)

Material examined. Lectotype. ♂ (5.6 mm), off Jolo Light, Philippine Islands, 15 Feb 1908, c. 53 m, on surface of brown sponge, *Albatross* stn. 5141 (USNM 273516).

Paralectotypes. ♂ (5.2 mm), 35♀ and immature specimens, same data as holotype (USNM 40918).

Description of male. Body about 2.1 times as long as greatest width; dorsal surfaces not polished, generally granular, with scattered setae. Cephalon dorsal surface not nodulose; anterior margin without nodules; without spike on rostrum. Pereonite 1 without tubercles or ornamentation. Pereonites 2–3 with 2 transverse rows of low spikes, pereonites 4–6 each with 2 transverse rows of prominent acute spikes, anterior and posterior rows about subequal in size; pereonite 7 posterior margin weakly produced, with weak median indentation, without posterior row of spikes, covered with small posteriorly directed acute tubercles; coxae 5 and 7 with posterior margins evenly rounded, coxa 6 ventroposteriorly subtruncate. Pleon with posterior boss, with posterolateral angles of boss each with prominent posteriorly directed spikes and 2 additional tubercles; pleonite 3 with sublateral tubercle. Pleotelson with 2 prominent spikes opposing those of pleon, dorsal surface moderately granular, with lateral row of 5 prominent sublateral tubercles running longitudinally, 3 prominent median tubercles placed longitudinally anterior to pleotelson apex; posterolateral flange with 2 acute tubercles; posterior margin with 2 submedian indentations on either side of median lobe, each point with prominent dorsal tubercle.

Antennule peduncle article 1 with 8 anterior spikes, with 1 long proximo-posterior spike, 1 very short posterior spike, and 1 posterodistal spike; peduncle article 2 with prominent anteroproximal tubercle and small medial tubercle; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae; flagellum with 7 articles.

Epistome with 2 prominent conical spikes, basally somewhat flattened, on basal transverse ridge, lateral lobes each with small tubercle.

Pereopods essentially the same as *O. obregonia.*

Penial processes not examined in detail, similar to those of *O. obregonia.*

Pleopod 1 endopod medial margin with PMS along proximal two-thirds. Pleopod 2 appendix masculina straight, 5.3 times as long as maximum width, shorter than (0.74) as endopod, not

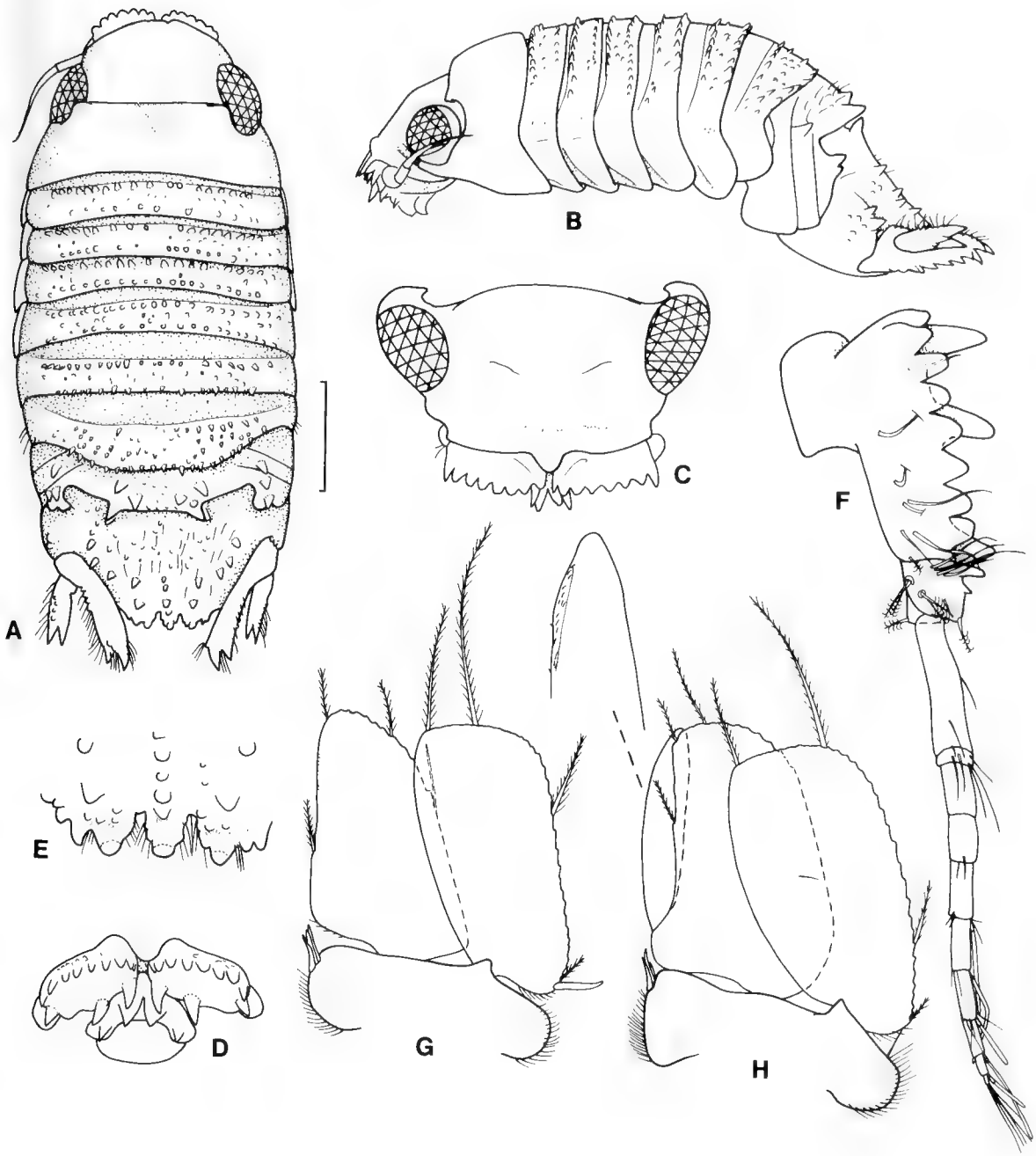


Figure 24. *Oxinasphaera multidens* (Richardson). A–E lectotype, F–G paralectotype ♂. A, dorsal view; B, lateral view; C, cephalon; D, frons; E, pleotelson apex; F, antennule; G, pleopod 1; H, pleopod 2; Scale 1.0 mm.

extending beyond endopod, apex narrowly rounded. Uropod not examined in detail, generally similar to *O. obregonia*; exopod about half as long as endopod, apex with 3 prominent and 1 smaller ventrally directed spikes.

Female. Not differing from others of the group.

Colour. Faded in alcohol to a pale yellow colour.

Size. Males 5.2–5.6 mm.

Remarks. Richardson's (1910) description was based on specimens from two stations, both from near Jolo Light, Philippines. Implicit in her remarks is that material from station 514, the type locality, contained numerous males. Similarly implicit is that the material from station 4145 contained only a single male. In her description Richardson (1910: 27) stated that there was "one small median point instead of two." In this she was not quite accurate as *O. multidens* does, as do all species of the genus, have a single rostrum, but lacks any trace of a rostral spike. Given that there is some ambiguity over the status of all the material that Richardson reported on, and also as a formal redescription is given here, the larger male from the tpe locality is designated as the lectotype.

The species is readily identified by the unique pattern of pleonal tubercles, and the antennular morphology of peduncle article 1 having 8 anterior and 3 posterior spikes and peduncular article 2 having a prominent tubercle on the anterior margin.

This species is one of a group of central Indo-Pacific species, generally similar to *O. bisubula*, but is principally characterized by having elongate penial processes and a single rostral spike when present. The other species are *Oxinasphaera obregonia* sp. nov. and *Oxinasphaera tual* sp. nov.

Distribution. Known only from the type locality, at a depth of about 53 m.

Hosts. Unidentified sponge.

Oxinasphaera corypantha sp. nov.

Figure 25

Material examined. Holotype. ♂ (4.3 mm), Ilot Maitre, Nouméa, New Caledonia, Oct 1978, 20 m, from *Siphonochalina*, Yves Magnier (QM W20040).

Paratypes. 6♀ (non-ovig 3.0, 3.1, 3.3, 3.5, 3.6, 3.8 mm), 4 imm (2.5, 2.5, 2.7, 2.7 mm), 2 broken, 4 mancas (1.8–2.0 mm), same data as holotype (QM W8083).

Description of male. Body about 2.2 times as long as greatest width; dorsal surfaces polished, generally granular, with scattered setae. Cephalon dorsal surface not nodulose; anterior margin without nodules on either side of rostrum; rostrum without spike. Pereonite 1 with indistinct posterior ridge, surface of which is weakly tuberculate. Pereonite 2 weakly tuberculate; pereonites 3–6 each with 2 transverse rows of prominent acute spikes, anterior row slightly larger than posterior row; pereonite 7 with only anterior spike row distinct, posterior margin bisinuate; coxae 4 and 5 posterior margins weakly concave, coxa 7 posteriorly rounded. Pleon with posterior boss, with posterolateral angles strongly produced, produced portions each with prominent posterior spike and 1 small anterior spike; pleonite 3 with 1 lateral tubercle. Pleotelson with 2 spikes opposing those of pleon, dorsal surface weakly granular and setose, with 2 additional lateral tubercles on each side; posterolateral flange with 2 acute tubercles; posterior margin with 2 submedian indentations on either side of median lobe; median lobe slender, distinctly shorter than sinus.

Antennule peduncle article 1 with 9 anterior spikes; with 1 long proximo-posterior spike and 1 shorter posterior spike; peduncle article 2 with 1 indistinct anterior spike; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae.

Epistome with 2 prominent conical spikes, basally somewhat flattened.

Pereopods essentially the same as *O. bisubula*.

Penial processes essentially the same as *O. bisubula* (examined in situ).

Pleopod 1 medial margin with subproximal ventral groove. Pleopod 2 appendix masculina straight, 7.6 times as long as maximum width, distolateral margin curving at apex, longer (1.1) than endopod, extending slightly beyond endopod by about 0.16 of its length), apex bluntly rounded. Uropod not examined in detail, similar to that of *O. bisubula* or *O. multidens*.

Female. No ovigerous females observed, and the maturity of the "non-ovigerous" females in the sample is unclear. Generally indistinguishable from others of the group.

Colour. In alcohol, pale cream yellow colour, females with scattered brown chromatophores over dorsal surfaces.

Size. Males 4.3 mm, non-ovigerous females 3.0–3.8 mm.

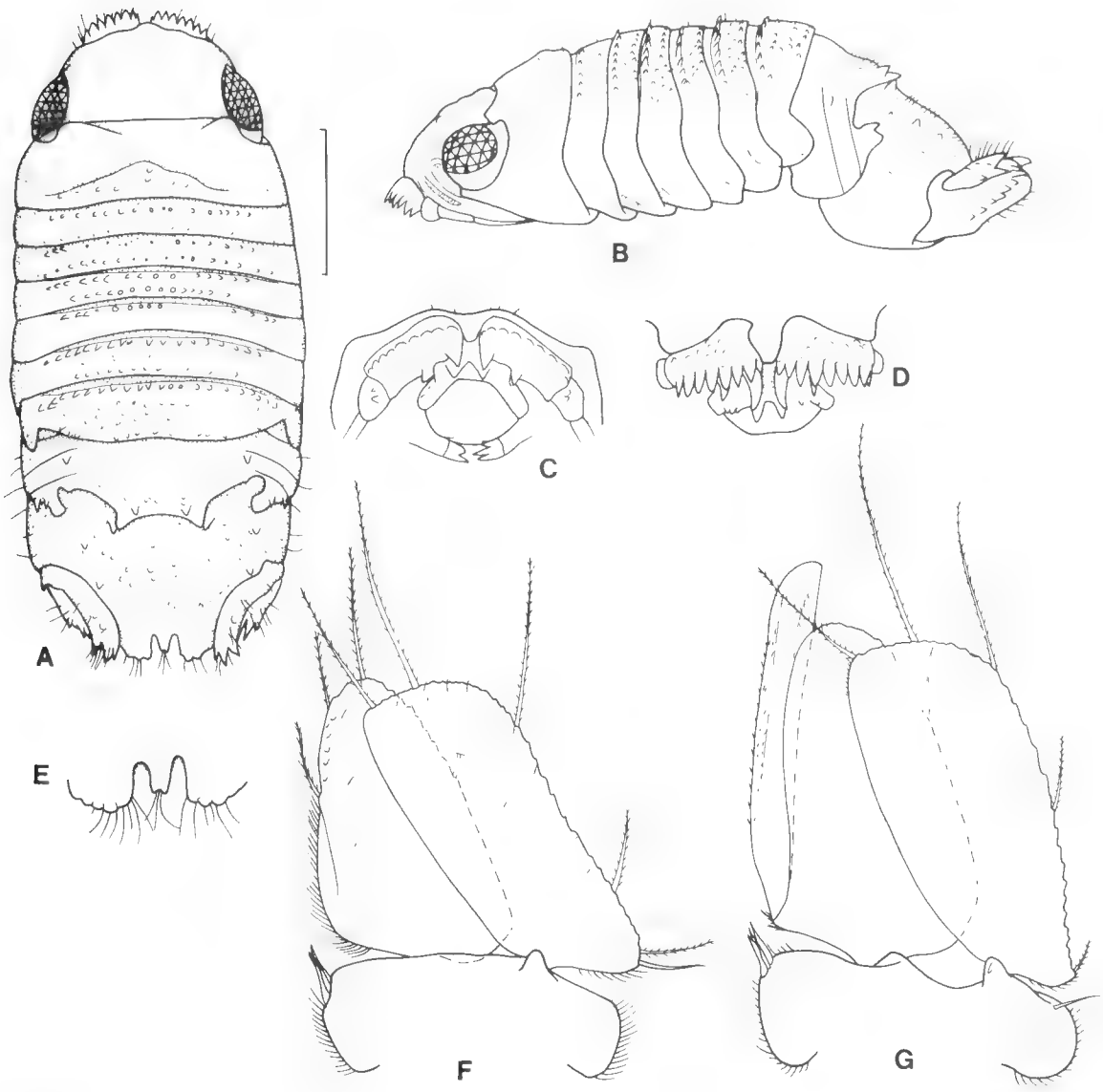


Figure 25. *Oxinasphaera corypantha* sp. nov. All figs of holotype. A, dorsal view; B, lateral view; C, frons; D. antennules, anterior view; E, pleotelson apex; F, pleopod 1; G, pleopod 2. Scale 1.0 mm.

Remarks. The details given here for the antennule and uropod are brief as these appendages were not dissected off on order to preserve the integrity of the single male (holotype) specimen.

The prominence of the pleonal posterior lobe almost approaches the form of processes, and that character along with the posterior ridge on pereonite 1, the generally weakly developed pereonal spike rows and the short and slender median telsonic process all serve to identify this species. *Oxinasphaera multidens* is the only other species that lacks a rostral spike, and that species has a far more prominent pereonal spikes, numerous secondary tubercles on the pleon, a robust telsonic median lobe and the appendix masculina not longer than the endopod of pleopod 2.

Distribution. Known only from the type locality, Ilot Maitre, Nouméa, New Caledonia.

Hosts. Recorded from the sponge *Siphonochalina* sp.

Oxinasphaera obregonia sp. nov.

Figure 26

Material examined. Holotype. ♂ (3.6 mm), N of Straits of Sunda, Java, Indonesia, 05°40′S, 106°08′E, 28 Aug 1922, 54 m, numerous sponges [Sigsbee trawl], stn. 71, Th. Mortensen's Kei Is. Expedition 1922 (ZMUC CRU1391).

Paratypes. 6♂ (3.5, 3.5, 3.6, 3.6, 3.7, 3.8 mm), imm (2.5 mm), same data as holotype (ZMUC CRU1390).

Non-paratypic material. ♂ (3.7 mm), ♀ (3.0, 3.2, 3.3 mm), imm (2.7 mm), same data as holotype, but station number 11 (ZMUC CRU1389).

Description of male. Body about 2.3 times as long as greatest width; dorsal surfaces not polished, generally granular, with scattered setae. Cephalon dorsal surface not nodulose; anterior margin with 3–4 small lateral nodules on either side of rostrum; with prominent single acute spike on rostrum. Pereonite 1 without tubercles or ornamentation. Pereonites 2 and 3 with 2 transverse rows of spikes, pereonites 4–6 each with 2 transverse rows of prominent acute spikes, anterior row slightly larger than posterior row; pereonite 7 with posterior row of low spikes; coxae 5 and 7 with posterior margins evenly rounded, coxa 6 ventro-posteriorly concave. Pleon with weakly developed posterior boss, with posterolateral angles of boss each with small spikes. Pleotelson with 2 spikes opposing those of pleon, dorsal surface weakly granular, without additional tubercles; posterolateral flange with 1 acute tubercle; posterior margin with 2 submedian indentations on either side of median lobe, each point with distinct dorsal tubercle.

Antennule peduncle article 1 with 7 anterior spikes; with 1 long proximo-posterior spike and 1 shorter posteromedial spike; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae; flagellum with 6 articles.

Epistome with 2 prominent conical spikes, basally somewhat flattened.

Pereopods essentially the same as *O. bisubula*, but propodus of pereopod 7 with very prominent spines, the longest of which are as long as the propodus.

Penial processes each about 4.1 times as long as basal width, both margins tapering towards slender apex.

Pleopod 2 appendix masculina straight, 5.6 times as long as maximum width, about as long (0.97) as endopod, extending slightly beyond endopod (by about 0.10 of its length), apex narrowly rounded. Uropod exopod about 4.7 times as long as proximal width, about 0.5 times as long as endopod, apex deeply bifid with lateral process prominent; endopod about 3.0 times as long as wide, apex with 3 prominent ventrally directed spikes.

Female. Similar to other species of the *O. bisubula* group.

Colour. Faded in alcohol to a pale yellow colour.

Size. Males 3.5–3.8 mm, ovigerous female 3.0–3.3 mm.

Remarks. The sample from station number 11 is excluded from the type series as the label data is incompatible with the station number, and therefore the locality cannot be regarded as certain. All females from this sample are in poor condition, and are therefore not described.

The single rostral spike immediately separates *O. obregonia* from all other species of the genus except *O. tual*. Both of these species are further characterized by having slender elongate penial processes. *O. obregonia* is distinguished from *O. tual* by having close set epistome spikes without an additional pair of smaller spikes between, very weakly developed pleonal boss, antennule peduncle article 1 with 7 spikes and article 2 without a spike, pleopod 1 medial margin simple and the appendix masculina being of even width.

Distribution. Known only from the type locality, at a depth of about 54 m..

Hosts. Unidentified sponges.

Oxinasphaera tual sp. nov.

Figure 27

Material examined. Holotype. ♂ (4.5 mm), off Tual, Kei Is., (now Pulau Kai, Dulah), Indonesia, c. 05°37′S, 132°43′E, 21 Mar 1922, 2 m, from sponges, Th. Mortensen's Kei Is. Expedition 1922 (ZMUC CRU1394).

Paratypes. 4♂ (3.7, 3.9, 4.0, 4.2 mm), 5♀ (ovig 3.5, non-ovig 3.0, 3.0, 3.2, 3.3 mm), same data as holotype (ZMUC CRU1395). Note: No station number is associated with this sample, presumably hand collected.

Description of male. Body about 2.1 times as long as greatest width; dorsal surfaces not polished, generally granular, with scattered setae. Cephalon dorsal surface not nodulose; anterior margin with 4–5 small nodules on either side of rostrum; with single acute spike on rostrum. Pereonite 1 without tubercles or ornamentation. Pereonites 2–7 with 2 transverse rows of small

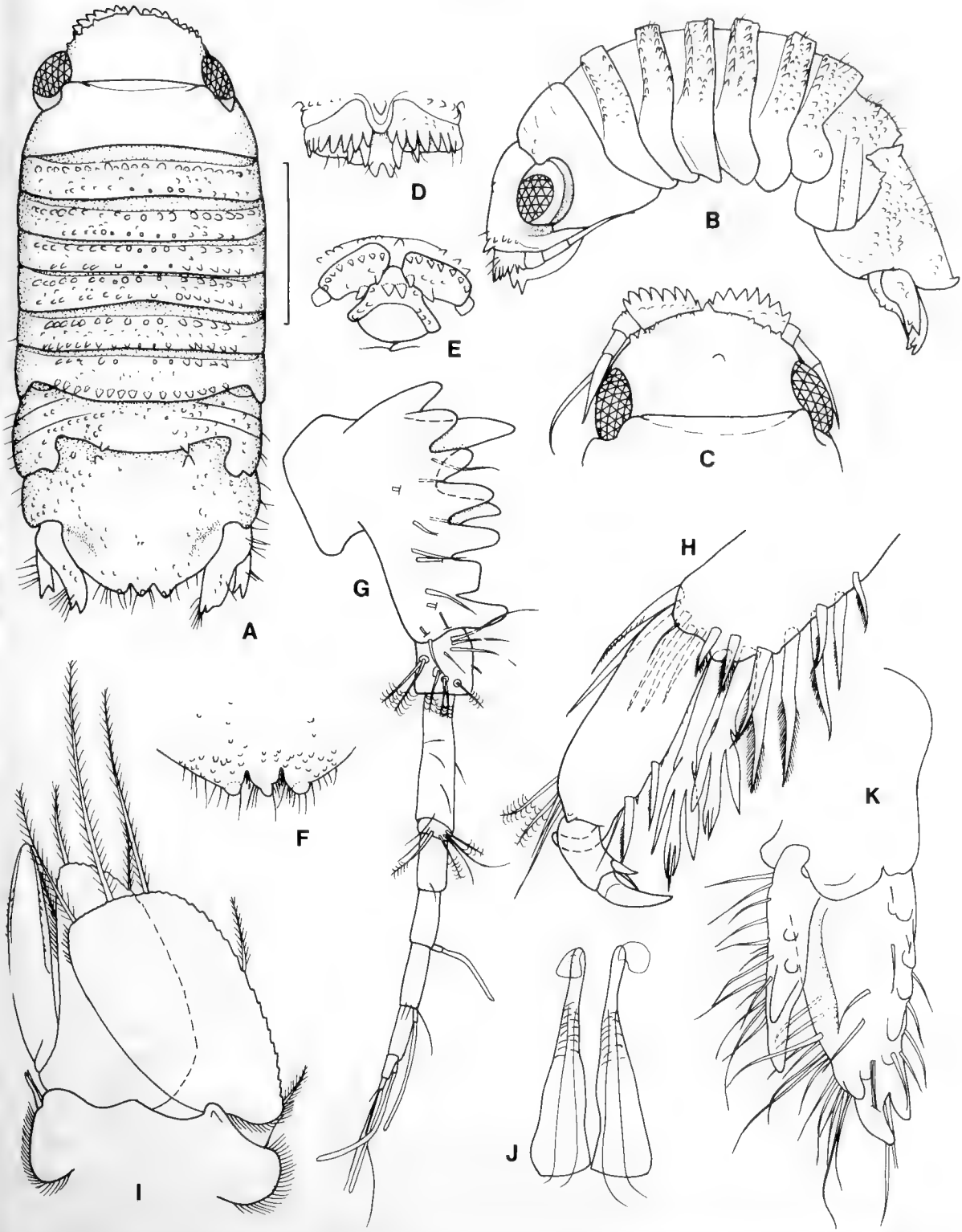


Figure 26. *Oxinasphaera obregonia* sp. nov. A–F holotype, G–J paratype ♂ 3.6 mm. A, dorsal view; B, lateral view; C, cephalon; D, antennules, anterior view; E, frons; F, pleotelson apex; G, antennule; H, pereopod 7, distal articles; I, pleopod 2; J, penes; K, uropod. Scale 1.0 mm.

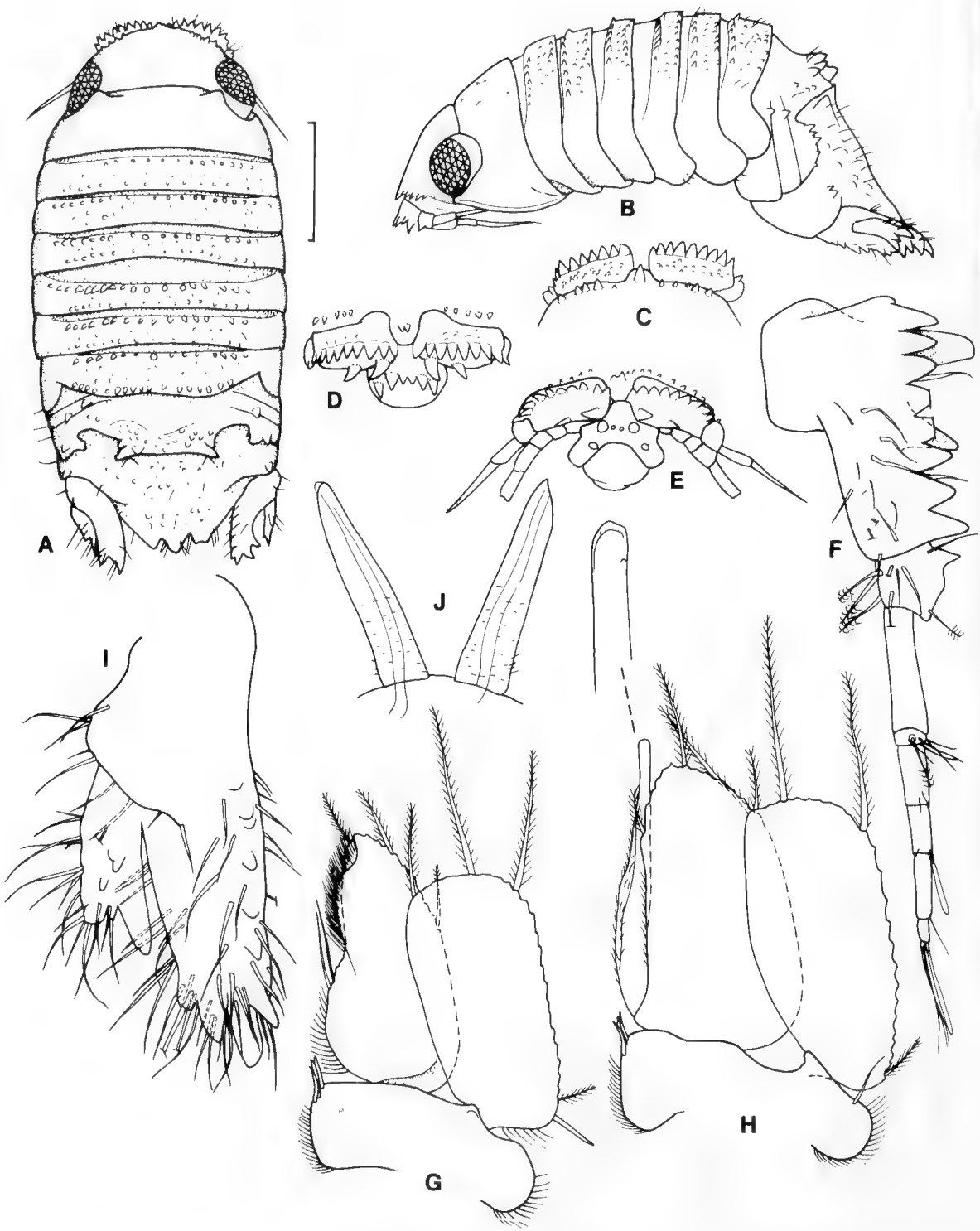


Figure 27. *Oxinasphaera tual* sp. nov. A–E holotype, F–J paratype ♂ 4.0 mm. A, dorsal view; B, lateral view; C, cephalon, anterior margin; D, antennules, anterior view; E, frons; F, antennule; G, pleopod 1; H, pleopod 2; I, uropod; J, penes. Scale 1.0 mm.

spikes, pereonites 3–7 each with anterior spike row more prominent acute; pereonite 7 with posterior row of low spikes; coxae 5 and 6 with posterior margins subtruncate, coxa 7 ventroposteriorly rounded. Pleon with prominent posterior boss, each posterolateral angle with 2 distinct spikes positioned anteriorly to posterior spike; pleonites 2 and 3 each with lateral acute tubercle. Pleotelson with 2 spikes opposing those of pleon, dorsal surface weakly granular, without additional tubercles; posterolateral flange with 2–3 acute tubercles; posterior margin with 2 submedian indentations on either side of median lobe.

Antennule peduncle article 1 with 9 anterior spikes; with 1 long proximo-posterior spike and 1 shorter posterior spike; peduncle article 2 with 1 anteroproximal spike; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae; flagellum with 4 articles.

Epistome with 2 prominent conical widely separated spikes, between which lie 2 small spikes; lateral lobes each with 1 low tubercle.

Pereopods essentially the same as *O. bisubula*.

Penial processes basally distinctly separate, each process about 4.5 times as long as basal width, both margins tapering towards slender apex.

Pleopod 1 medial margin with stiff setae set proximally to prominent ventral lobe, medial margin of which is densely setulose. Pleopod 2 appendix masculina straight, 9.0 times as long as maximum width, about as long (0.99) as endopod, extending slightly beyond endopod (by about 0.08 of its length), distal 0.4 abruptly narrowed, apex subtruncate. Uropod exopod about 3.7 times as long as proximal width, about 0.5 times as long as endopod, apex deeply bifid with lateral process prominent; endopod about 4.0 times as long as wide, apex with 4 prominent ventrally directed spikes.

Female. Similar to other females of the group; ovigerous females not observed

Colour. Faded in alcohol to a pale yellow colour.

Size. Males 3.7–4.5 mm, ovigerous females 3.0–3.5 mm.

Remarks. This species belongs the group which the pleon has a posterior boss and a distinct spike at the posterolateral angles of the boss. Of that group there are several Indo-Pacific species that either lack the rostral spike or have a single spike. These species are *Oxinasphaera multidens* and *Oxinasphaera corypantha* sp. nov. (without a rostral spike), *Oxinasphaera obregonia* sp. nov and the present species (with a rostral spike). *Oxinasphaera obregonia* and *O. tual* are readily separated by differences in pleonal morphology, the posterior pleonal process in *O. tual* being both prominent and prominently armed, and by *O. tual* having a medial lobe on pleopod 1 endopod and the appendix masculina being flask shaped.

Distribution. Known only from the type locality.

Hosts. Unidentified sponge.

Etymology. The epithet is taken from the type locality (noun in apposition).

Oxinasphaera rebutia sp. nov.

Figure 28

Material examined. Holotype. ♂ (4.4 mm), E of Malabar, 33°58′S, 151°17′E, NSW, 3 Dec 1973, 66 m, AMSBS (AM P22196).

Paratypes. 3♂ (5.2, 5.0, 4.6 mm), ♀?(3.8 mm), 9 km E of Coogee, NSW, 33°57′S, 151°21′E, 89 m, no date, about 1898 to 1914?, fine sand, E.R. Waite on HMCS *Thetis* (AM P44206).

Non-paratypic material. 3♂ (3.5, 3.7, 3.7 mm), E of North Head, Port Jackson, NSW, 33°49′S, 151°18′E, 2 Feb 1973, 25.9 m, from unidentified sponge, AMSBS (AM P22983).

Description of male. Body about 2.2 times as long as greatest width; lateral margins subparallel. Cephalon granular, anterior margin without tubercles; rostrum without spike. Pereonite 1 granular, with posteromedian cluster of 5 prominent rounded tubercles, median tubercle being twice as large as others. Pereonites 2–7 each with 2 transverse rows of rounded spikes, posterior row weak; pereonites 2 and 3 with median 3 spikes conspicuously more prominent than remainder; coxae 5 and 7 rounded, 6 subtruncate. Pleon without posterior boss, with numerous large rounded tubercles. Pleotelson granular, without spikes, posteriorly with distinct low rounded tubercles; posterolateral flange without prominent tubercles; posterior margin deep, laterally depressed, posterior margin deeply excavate, with short rounded median process dorsally with single distinct low rounded tubercle, and longitudinal row of low rounded tubercles.

Antennule peduncle article 1 with 9 elongate subacute anterior spikes, medial spike being smaller than remainder; with 1 posteroproximal

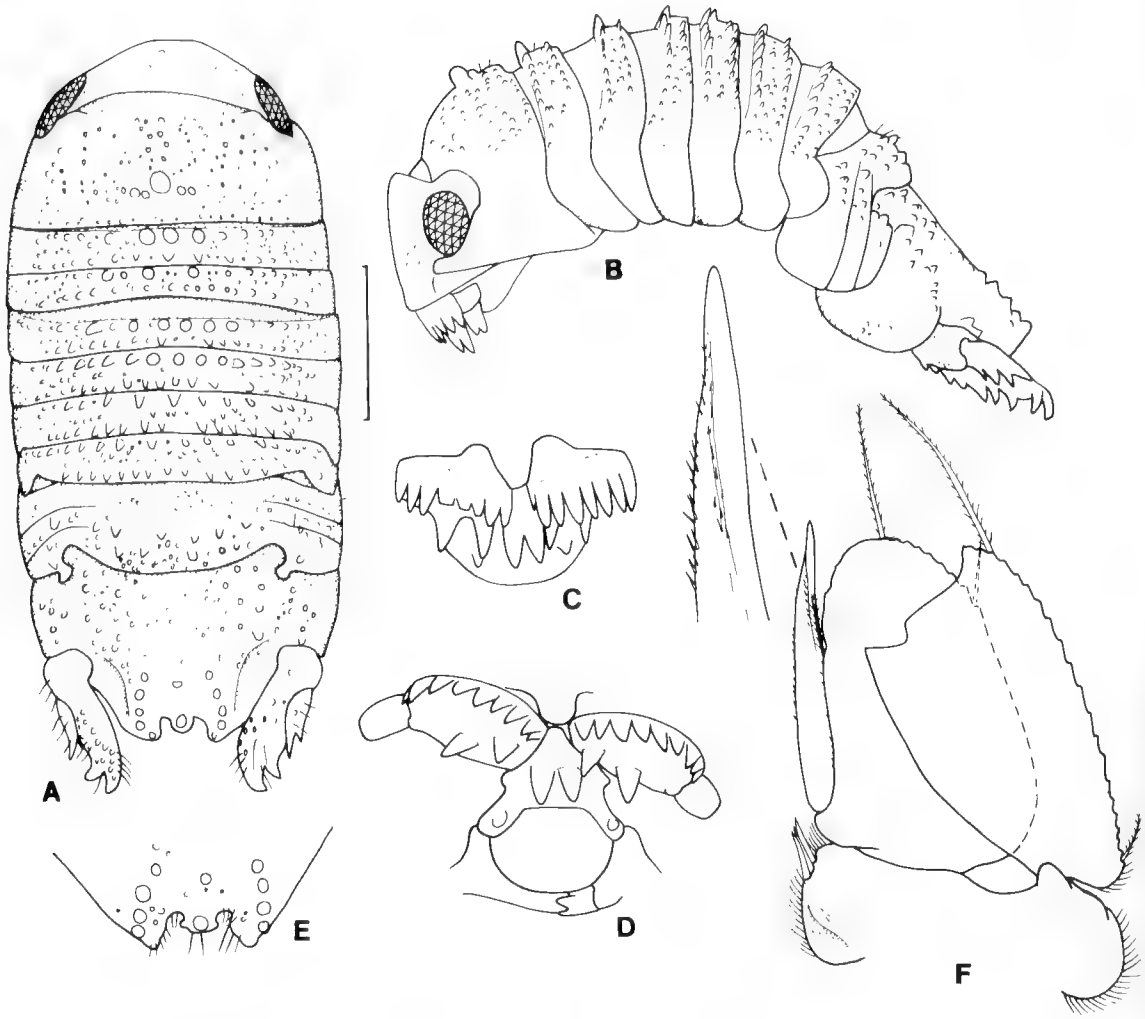


Figure 28. *Oxinasphaera rebutia* sp. nov. All figs of holotype. A, dorsal view; B, lateral view; C, antennules, anterior view; D, frons; E, pleotelson apex; F, pleopod 2. Scale 1.0 mm.

and 1 posteromedial spike subequal in size; dorsal surface of peduncular articles 1 and 2 with few setae; flagellum with 7 articles.

Epistome with 2 long basally united distinct spikes; lateral posterolobes with weak tubercle.

Percopods not examined in detail.

Penial processes examined in situ, about three times as long as basal width, apex subacute.

Pleopod 2 appendix masculina shorter (0.85) than endopod, 7.7 times as long as maximum width, extending slightly (0.07) beyond endopod, apex slender and acute. Uropod exopod about 4 times as long as proximal width, about half as long as endopod, apex deeply bifid with processes about equally prominent, ventral margin with prominent acute serrations; exopod about 4 times as long as wide, apex with 2 prominent downwardly projecting spikes, ventral margin with 4–5 prominent serrations.

Female. Unknown.

Colour. Pale tan in alcohol; chromatophores not observed.

Size. Males 3.5–5.2 mm.

Remarks. The characteristic tubercles on pereonite 1, granular surface of the cephalon and pereonite 1, lack of a rostral spike and telson morphology readily identifies this species. Only *O. aylostera* has a similar telson morphology and these two species can easily distinguished by *O. rebutia* lacking a rostral spike, and having a prominent cluster of tubercles on the posterior of pereonite 1.

The three specimens AM P22983 differ slightly from the others in that the pereonal and antennular spikes are poorly developed, and are excluded from the type series. Two of the specimens have a poorly developed median spike on the posterior of pereonite 1, and all agree with *O. rebutia* in lacking rostral spikes, and in the morphology of the antennule, uropods, pleon and pleotelson.

The old specimens were too fragile to dissect, and therefore the description given here is brief and taken only from the holotype.

Distribution. All specimens taken in the vicinity of Sydney, New South Wales, at depths from 26 to 89 m.

Hosts. One sample from an unidentified sponge.

Oxinasphaera aylostera sp. nov.

Figures 29, 30

Material examined. Holotype. ♂ (4.2 mm), N of Fly Point, Port Stephens, NSW, 32°43′S, 152°09′E, 8 Nov 1981, 20 m, orange sponge on dead mussel, R.T. Springthorpe and D. Stracey (AM P44204).

Paratypes. **NSW.** 3♀ (ovig 3.8, non-ovig 3.8, 3.6 mm), same data as holotype (AM P41153). ♂ (4.3 mm), Nelson Head, Port Stephens, 32°43′S, 152°09′E, 27 Oct 1980, 24 m, rubble on stones in channel, J. Hall (AM P44193). ♂ (4.2 mm), Barrenjoey Head, Broken Bay, 33°35′S, 151°20′E, 22 Apr 1983, 5 m, sponge, J.K. Lowry (AM P41157).

Vic. 2♂ (4.0, 4.0 mm), 4♀ (ovig 3.6, non-ovig 3.0, 3.4, parasitized 3.8 mm), SW shore, Gabo Is, 34°58′S, 149°55.7′E, 19 Feb 1973, 28 m, sponge community between lighthouse and jetty, J.E. Watson and S.A. Shepherd (NMV J40480).

Non-paratypic material. **NSW.** About 300 non-ovigerous females and mancas, same data as holotype (AM P44203). ♂ (4.5 mm), Barrenjoey Head, Broken Bay, 33°35′S, 151°20′E, 22 Apr 1983, 2 m, yellow sponge, J.K. Lowry (AM P41158).

Description of male. Body about 2.1 times as long as greatest width; lateral margins subparallel. Cephalon anterior margin without tubercles; rostrum with prominent bifurcate acute spike. Pereonite 1 unornamented. Pereonites 2–7 each with 2 transverse rows of spikes, anterior row distinctly larger than posterior on pereonites 2, 3 and 7, pereonite 2 with prominent median spike; coxae 5–7 rounded. Pleon without posterior boss, with 2 rounded tubercles at the usual position of boss, posterolateral margin of pleonite 3 with prominent tubercles. Pleotelson granular, without spikes, posteriorly with distinct low rounded tubercles; posterolateral flange with 1 marginal rounded tubercle; posterior margin deep, laterally depressed, posterior margin deeply excavate, with short rounded median process dorsally with single distinct low rounded tubercle.

Antennule peduncle article 1 with 8 elongate subacute anterior spikes; with 1 long posteroproximal and 1 posteromedial spike; dorsal surface of peduncular articles 1 and 2 with few setae; flagellum with 7 articles.

Epistome with 2 long basally united distinct spikes; lateral lobes unornamented.

Pereopod 7 carpus 1.4 times as long as merus, about twice as long as wide, posterior margin with 3 biserrate, 2 simple spines, distal margin with 3 large trifid spines, largest nearly as long as carpus, and 4 biserrate spines, anterodistal angle with 2 slender weakly biserrate spines; propodus 1.1 times as long as carpus, 3.2 times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 2 sensory setae.

Penial processes 3.3 times as long as basal width; medial margin straight, lateral margin curving to subacute apex; proximolateral margin with scale spikes.

Pleopod 2 appendix masculina shorter (0.8) than endopod, 6.7 times as long as maximum width, not extending beyond endopod, apex bluntly rounded. Uropod dorsally nodular; exopod about 4 times as long as proximal width, about half as long as endopod, apex deeply bifid with processes about equally prominent, ventral margin with prominent acute serrations; exopod about 4 times as long as wide, apex with 2 prominent downwardly projecting spikes, ventral margin with 4–5 prominent serrations.

Female. Pleotelson smoothly rounded; posterior margin with weak indistinct median indentation.

Colour. Pale tan in alcohol; chromatophores not observed.

Size. Males 3.6–4.5 mm, females (ovigerous and non-ovigerous) 3.6–3.8 mm.

Remarks. This species and *Oxinasphaera rebutia* can be separated from all others of the genus by the posterior margin of the pleon not being produced and pleotelson posterior margin having a deep profile with a wide and deep median excavation which houses a short median process. This process is ornamented by a distinct rounded tubercle, and the lateral lobes on either side have a longitudinal row of similar tubercles. The two species also have prominent and acute antennule spikes and an elongate bifurcate

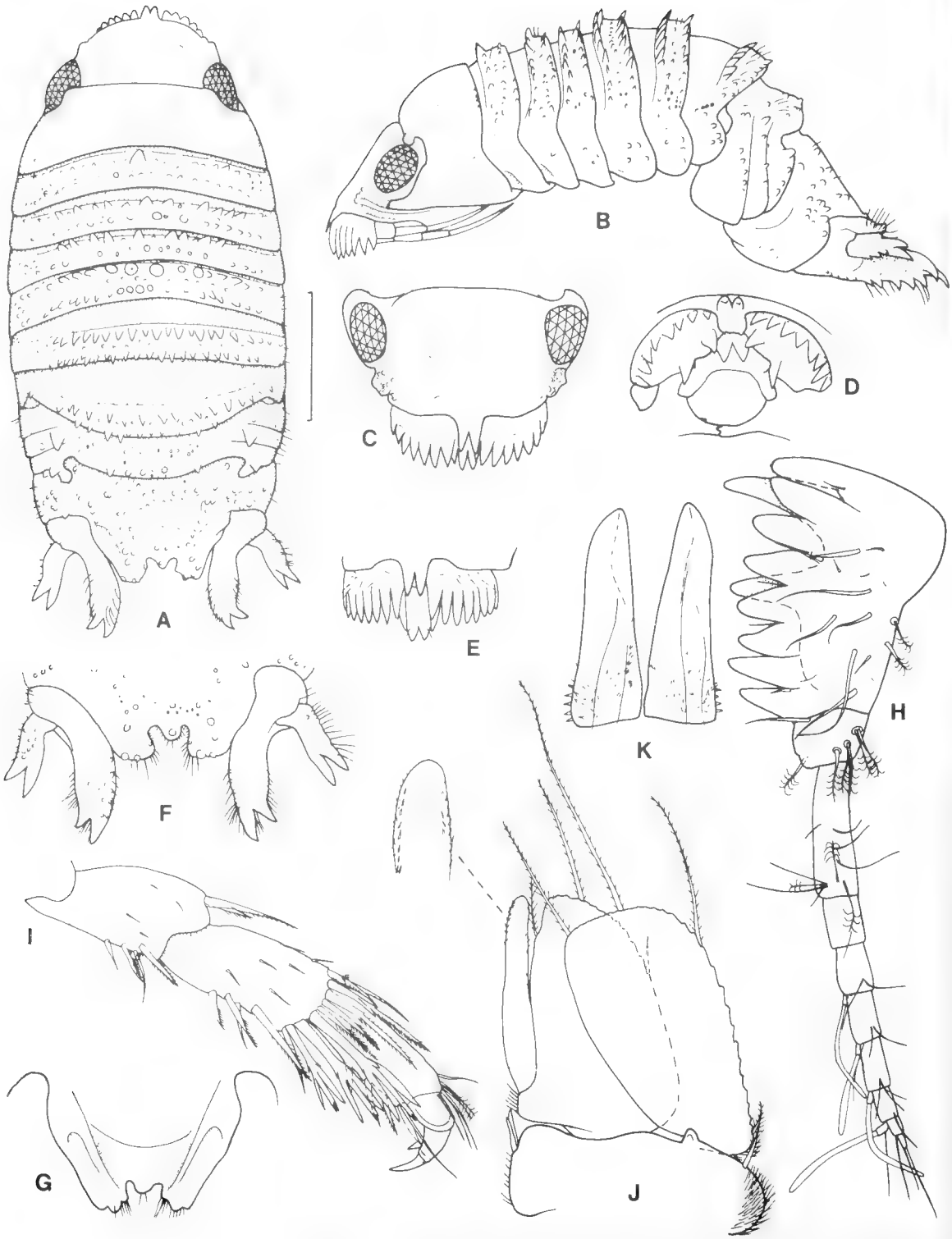


Figure 29. *Oxinasphaera aylostera* sp. nov. A–G, J holotype, remainder paratype ♂ 4.8 mm NMV J26423. A, dorsal view; B, lateral view; C, cephalon; D, frons; E, antennules, anterior view; F, pleotelson posterior margin; G, pleotelson posterior margin, ventral view; H, antennule; I, pereopod 7, distal articles; J, pleopod 2; K, penes. Scale 1.0 mm.

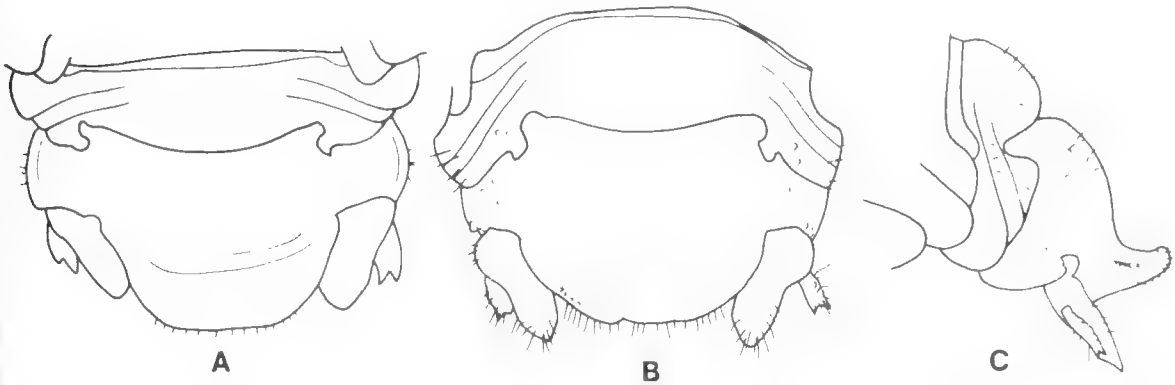


Figure 30. *Oxinasphaera aylostera* sp. nov., AM P41153. A, non-ovigerous ♀, pleon and pleotelson; B, ovigerous ♀, pleon and pleotelson; C, ovigerous female, pleon and pleotelson, lateral view.

epistome spike. *Oxinasphaera aylostera* is recognized by pereonite 2 having a prominent median spike, and the anterior spike rows on pereonites 3 and 4 being larger than is usual in the genus. It is readily distinguished from *O. rebutia* by having a rostral spike, and by lacking prominent tubercles on pereonite 1.

Distribution. Port Stephens, NSW to Gabo Is., eastern Victoria, at depths from 2 to 28 m.

Hosts. Unidentified sponges.

Oxinasphaera tuberculosa
(Stebbing, 1873) comb. nov.

Figures 31–33

Cymodocea tuberculosa Stebbing, 1873: 96, pl. 3 figs 1–1b.

Cymodoce tuberculosa. — Baker, 1910: 76, pl. 21 figs 1–20.-Nierstrasz, 1931: 200.

Cymodoce tuberculosa tuberculosa. — Harrison and Holdich, 1984: 392 (remarks).

Non *Cymodoce tuberculosa.* — Whitelegge, 1902: 258, fig. 28 (= *Oxinasphaera thetisae* sp. nov.).

Non *Cymodoce tuberculosa.* — Baker, 1908: 140, pl. 3 figs 12–15 [= *O. bispinosa* (Baker, 1910)].

Non *Cymodoce tuberculosa bispinosa* Baker, 1910: 78, pl. 21 figs 21–23, pl 22 figs 1–7 [= *O. bispinosa* (Baker, 1910)].

Non *Cymodoce tuberculosa tripartita.* — Barnard, 1920: 363, pl. 15 fig. 28. — Barnard, 1940: 493 (key). — Kensley, 1978: 100, Fig. 42C (= *O. kensleyi* sp. nov).

Material examined. **WA.** ♂ (6.0 mm), 7♀ (4.8, 4.8, 4.9, 5.0, 5.5, 5.5, 5.6 mm), Bundegi Reef, near Point Murat, Exmouth Gulf, 21°49′S, 113°11′E, 4 Jan 1984, 9 m, large grey cup sponge, R.T. Springthorpe (AM P41351). ♂ (6.2 mm), Arthur Head, Fremantle, 32°03′S, 115°44′E, 25 Dec 1983, 6 m, from *Caulerpa*, J.K. Lowry (AM P41116). 40 ♂ and ♀ (previously partly desiccated), western end, Lucky Bay, 33°59.0′S, 118°02.5′E, 12 Apr 1984, 20 m, gorgonians and soft corals, G.C.B. Poore and H.M. Lew Ton (NMV J26181). 2 ♂ (5.4, 5.8 mm), ♀ (ovig 4.8 mm), N end of Little Beach, Two Peoples Bay, 34°58.2′S, 118°10.8′E, 18 Apr 1986, 5 m, yellow sponge, anemones, G.C.B. Poore and H.M. Lew Ton (NMV J26166). 3♂ (5.5, 5.6, 5.8 mm), ♀ (damaged, 5.0 mm), off Possession Point, King George Sound, 35°02.5′S, 117°55.0′E, 14 Dec 1983, 7 m, from purple finger sponges, R.T. Springthorpe (AM P41099). ♂ (5.8 mm), ♀ (4.8 mm), 17 mancas and juveniles (in poor condition), off SE corner of Michaelmas Is., King George Sound, 35°03′S, 118°00′E, 17 Dec 1983, 24 m, branching sponge, R.T. Springthorpe (AM P41108, slides P44218). ♂ (4.8 mm, senescent), NE end, Vancouver Peninsula, 35°03.4′S, 117°56.2′E, 8 Apr 1986, 6 m, dictyotaleans, G.C.B. Poore and H.M. Lew Ton (NMV J26163).

SA. 4♂ (4.5, 5.0, 5.3, 5.5 mm), ♀ (4.5 mm), Coal Reef, Tiparra Reef, Tiparra Bay, 34°04.0′S, 137°23.0′E, 15 Mar 1985, 5 m, sponges with hydroids and algae, G.C.B. Poore and H.M. Lew Ton (NMV J40481). ♂, Penneshaw jetty, 31 Jan 1989, sand and weed on pylons, 5–8 m, K.L. Gowlett-Holmes (SAM C5605). 3♂, Cape D'Estaing, 27 Jan 1989, 10–13 m, rubble, reef crevice, W. Zeidler and K.L. Gowlett-Holmes (SAM C5606). ♂, Pearson Is., Investigator Group, 10 Jan 1969, 33 m, algae on slope, S.A. Shepherd (SAM C5607). 10 specimens (in poor condition), Wedge Is., Gambier Group, 29 Dec 1963, 26 m, from sponge, SAORI (SAM C5608). ♀, West Is., Encounter Bay, 12 Feb 1966, ex sponge, S.A. Shepherd (SAM C5609). ♂, Whyalla, Upper Spencer Gulf, 33°02.4′S, 137°37.6′E, Sept 1987, 10 m, SA Fisheries Survey (C5610). ♂, Upper Spencer Gulf, Commissariat Point, 35°35.00′S, 137°46.08′E, Feb 1987, 6 m, beacon 20, S.A. Fisheries (C5611). 4 ♂, 'South Australian Coast', no other data, probably Baker's 1910 specimens (SAM C368).

Vic. ♂ (5.6 mm), SW shore midway between lighthouse and jetty, Gabo Is., 37°34′S, 149°55′E, 19 Feb 1973, 28 m, sponge community, J.E. Watson and S.A. Sheperd (NMV J40493).

Tas. ♂, 35 km N of Cape Wickham, King Is., 39°13.6′S, 143°55.6′E, 23 Nov 1981, 85 m, fine sand, R. Wilson (NMV J40495).

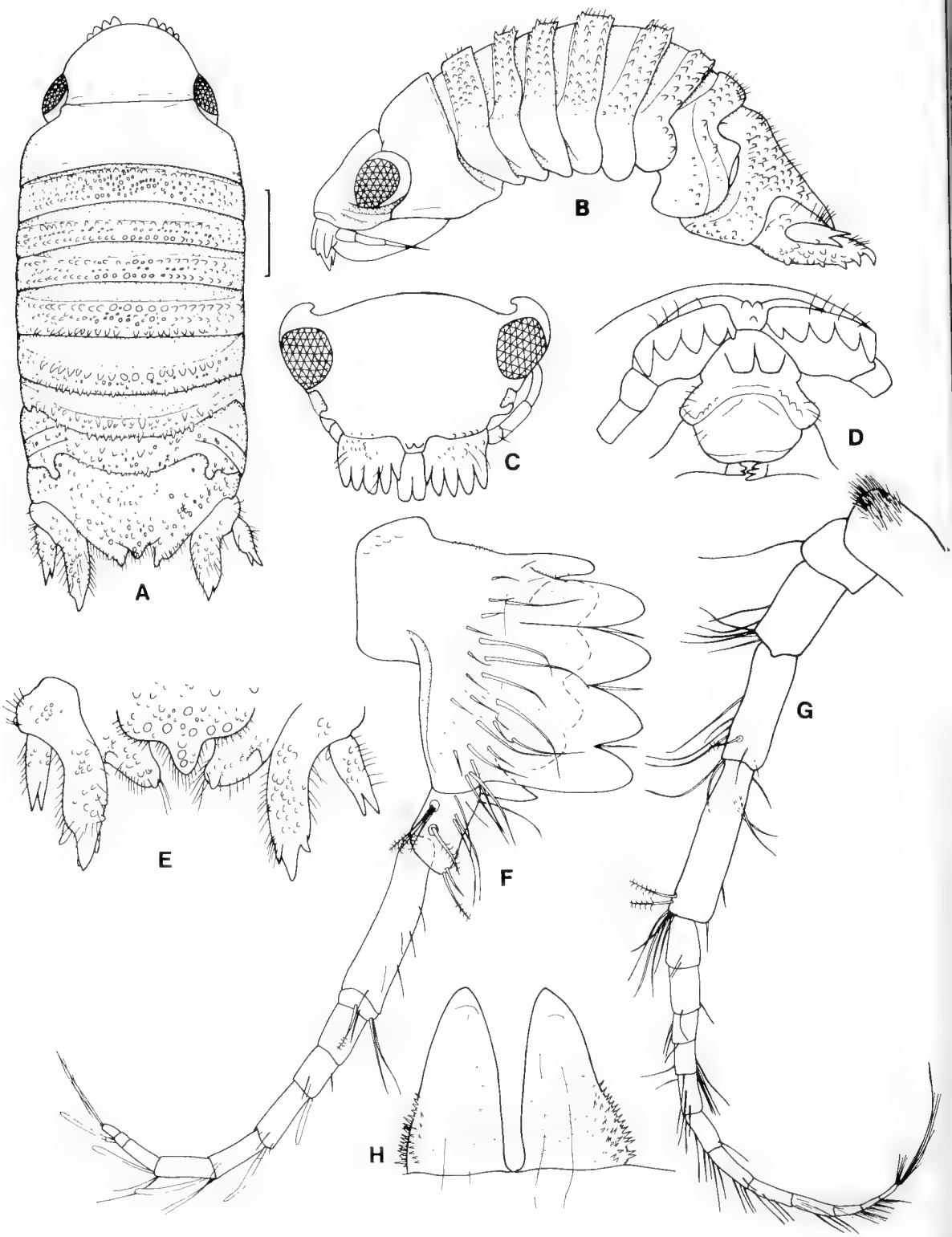


Figure 31. *Oxinasphaera tuberculosa* (Stebbing). A–E ♂ 6.2 mm, Fremantle (AM P41116), remainder ♂ 5.8 mm, King George Sound (AM P41108). A, dorsal view; B, lateral view; C, cephalon; D, frons; E, pleotelson posterior margin; F, antennule; G, antenna; H, penes. Scale 1.0 mm.

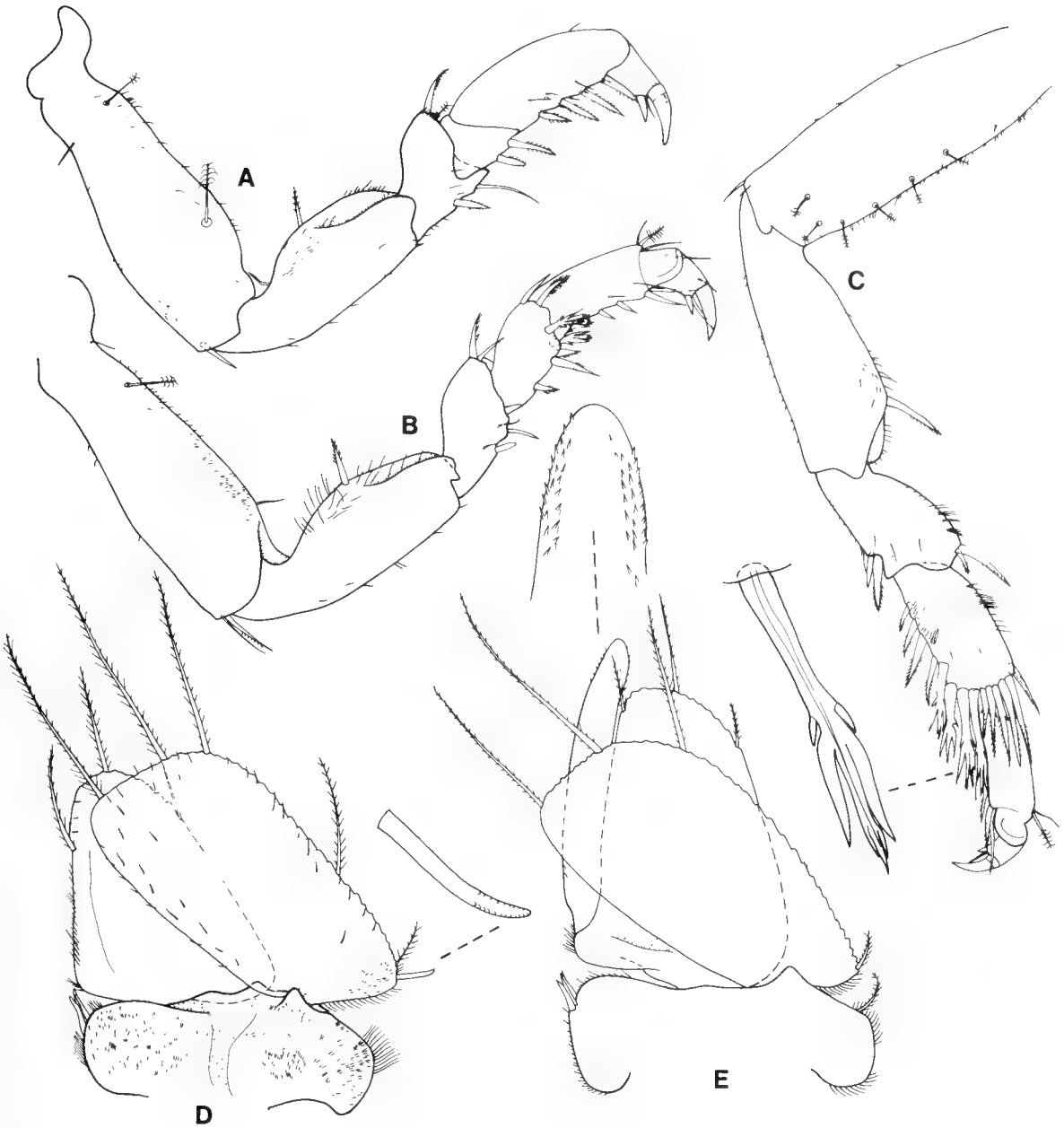


Figure 32. *Oxinasphaera tuberculosa* (Stebbing). All figs ♂ 5.8 mm, King George Sound (AM P41108). A, pereopod 1; B. pereopod 2; C, pereopod 7; D, pleopod 1; E, pleopod 2.

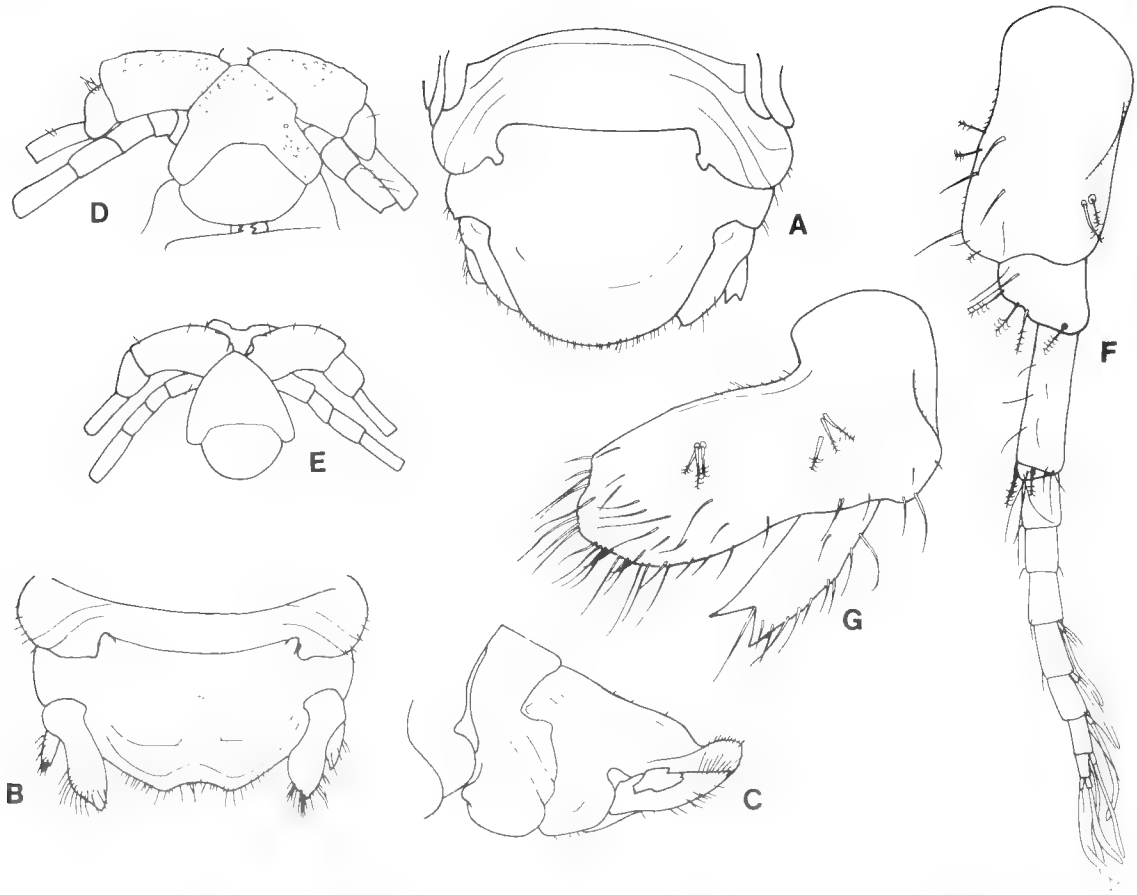


Figure 33. *Oxinasphaera tuberculosa* (Stebbing). A, D, F, G non-ovigerous ♀ 4.8mm, King George Sound (AM P41108); B, C, E ovigerous ♀ 4.8 mm, Two Peoples Bay (NMV J26166). A, pleon and pleotelson, dorsal view; B, pleon pleotelson, dorsal view; C, pleon pleotelson, lateral view; D, frons; E, frons; F, antennule; G, uropod.

Types. I have been unable to locate the material from the Swan River, WA on which Stebbing based his description. It is not held at The Natural History Museum, London, nor any other institution that I have contacted.

Description of male. Body about 2.5 times as long as greatest width; dorsal surfaces not polished, generally granular, with scattered setae. Cephalon dorsal surface not nodulose; anterior margin unornamented; rostrum without spike, with pair of very weak nodules. Pereonite 1 posterior margin finely granular. Pereonite 2 finely granular, and 3–7 each with 2 transverse rows of prominent spikes, anterior and posterior rows subequal in size; coxae 5–7 with posterior margins evenly rounded. Pleon without posterior boss, without prominent spikes. Pleotelson without prominent spikes or acute tubercles, prominent rounded tubercles on posterior lobe; posterolateral flange without acute tubercles; posterior margin with deep groove on either side of distinctly dorsal median lobe, telson on either side of apical notch forming distinct lobe, each with prominent spike.

Antennule peduncle article 1 with 4 large and 1 small medial flat anterior spikes; without posterior spikes; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae; flagellum with 8 articles.

Epistome with 2 prominent elongate flat truncate spikes, without subsidiary spikes.

Pereopod 1 basis about 2.8 times as long as wide, anterior margin with 2 sensory setae; ischium about 0.7 times as long as basis, about 2.4 times as long as wide, anterior margin with 1 short proximal spines and 1 distal longer and biserrate spine; merus about half as long as ischium, about 1.2 times as long as wide, anterolateral angle with 1 gently curving pectinate spine, posterior margin with 1 spine and single

long simple seta; carpus short, about 0.7 times as long as merus, about 1.1 times as long as wide, posterior margin with 2 biserrate spines; propodus about 0.8 times as long as ischium, widest proximally, about 2.5 times as long as wide, posterior margin with distinct scale spikes and 4 large biserrate spines, row of 4 smaller biserrate spines on medial margin; dactylus about 0.6 length of propodus, unguis about 55% length of entire dactylus. Pereopods 2 and 3 similar to 1, differing principally in carpus being more elongate and propodus more slender. Pereopod 2 basis about 3.0 times as long as wide; ischium about 2.5 times as long as wide; carpus about equal in length to merus, about 1.6 times as long as wide, with 3 biserrate and 3 trifid spines on posterior of distal margin; propodus about 0.7 times as long as ischium, about 3 times as long as wide, margins subparallel, posterior margin with 3 weakly biserrate spines. Pereopod 7 basis about 3.3 times as long as wide, posterior margin with prominent scale spikes, with several sensory setae; ischium slightly shorter than basis, about 2.7 times as long as wide; merus about 0.5 times as long as ischium, about 1.6 times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 1 large and 1 small spines; carpus about as long as merus, about 2.0 times as long as wide, posterior margin with 4 biserrate spines, distal margin with 4 large trifid spines and 5 biserrate spines, anterodistal margin with 1 weakly serrate spine; propodus about as long as carpus and 0.6 time as long as ischium, about 3.4 times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 1 sensory seta.

Penial processes each about 1.8 times as long as basal width, both margins converging evenly to an acute point; proximolateral margins densely scaled.

Pleopod 1 endopod without lobed or grooved medial margin. Pleopod 2 appendix masculina curving weakly laterally, 7.6 times as long as maximum width, about as long (0.97) as endopod, extending slightly beyond endopod (by about 0.16 of its length), apex bluntly rounded. Uropod exopod about 3.4 times as long as proximal width, about 0.45 times as long as endopod, apex deeply bifid with lateral process prominent; endopod about 3.4 times as long as wide, apex with prominent terminal spike and 2 smaller ventrally directed spikes.

Female. Ovigerous females with unornamented somites. Posterior margin of pleotelson upturned, with wide shallow indentation; with conspicuous marginal setae. Antennule peduncle article 2 0.4 as long as article 1, article 3 1.7 times as long as article 2; flagellum 0.8 times as long as peduncle, with 7 articles. Uropod endopod flat, distally with medial margin evenly rounded; exopod flat, about half as long as endopod, apex bifid. Non-ovigerous female with posterior margin of pleotelson not upturned, smoothly rounded, without wide shallow indentation. Antennule peduncle article 2 proportionally shorter than in ovigerous female, 0.24 as long as article 1; flagellum about three-quarters as long as peduncle. Uropod as for ovigerous female but endopod with rounded apical point.

Colour. Pale brown to cream in preserved specimens.

Size. Males 4.5–6.2 mm, females 4.5–5.6 mm.

Remarks. Oxinasphaera tuberculosa was one of the first described of the Australian marine isopods, but has since remained poorly known. The species is immediately characterized by the deep grooves extending anterolaterally from the posterior margin of the telson, and the very large flat truncate antennule and epistome spikes, characters that it shares with *Oxinasphaera epostoa* and *Oxinasphaera lowryi*. The latter is easily separated by having a single epistome spike, and the pleon with a posterior boss with opposing spikes on the pleotelson. *Oxinasphaera epostoa* is very similar but males of that species have a far more setose pleon and pleotelson, pereonite 2 and 3 are only weakly nodulose and the appendix masculina is straight and distally narrowed.

Distribution. From North West Cape, WA, southwards and eastward along the coast of southern Australia to Gabo Is., Victoria and Tasmania.

Hosts. From sponges, none of which have been identified.

Oxinasphaera epostoa sp. nov.

Figures 34, 35

Material examined. Holotype. ♂ (5.5 mm), Table Point, Cobourg Peninsula, Port Essington, NT, 11°14.8′S, 132°10.5′E, 12 May 1983, 6 m, rock washings, N.L. Bruce (NTM Cr0011329).

Paratypes. **NT.** 2♀ (4.0, 4.8 mm), same data as holotype (NTM Cr0011330). ♂ (4.3 mm), 13♀ (non-ovig mm), 17 mancas (mm), same data as holotype, but 11 May 1983, from *Callyspongia ?diffusa* (NTM Cr0011331). 3♂ (5.3, 6.0 dissected, 6.0 [SEM] mm), 6♀

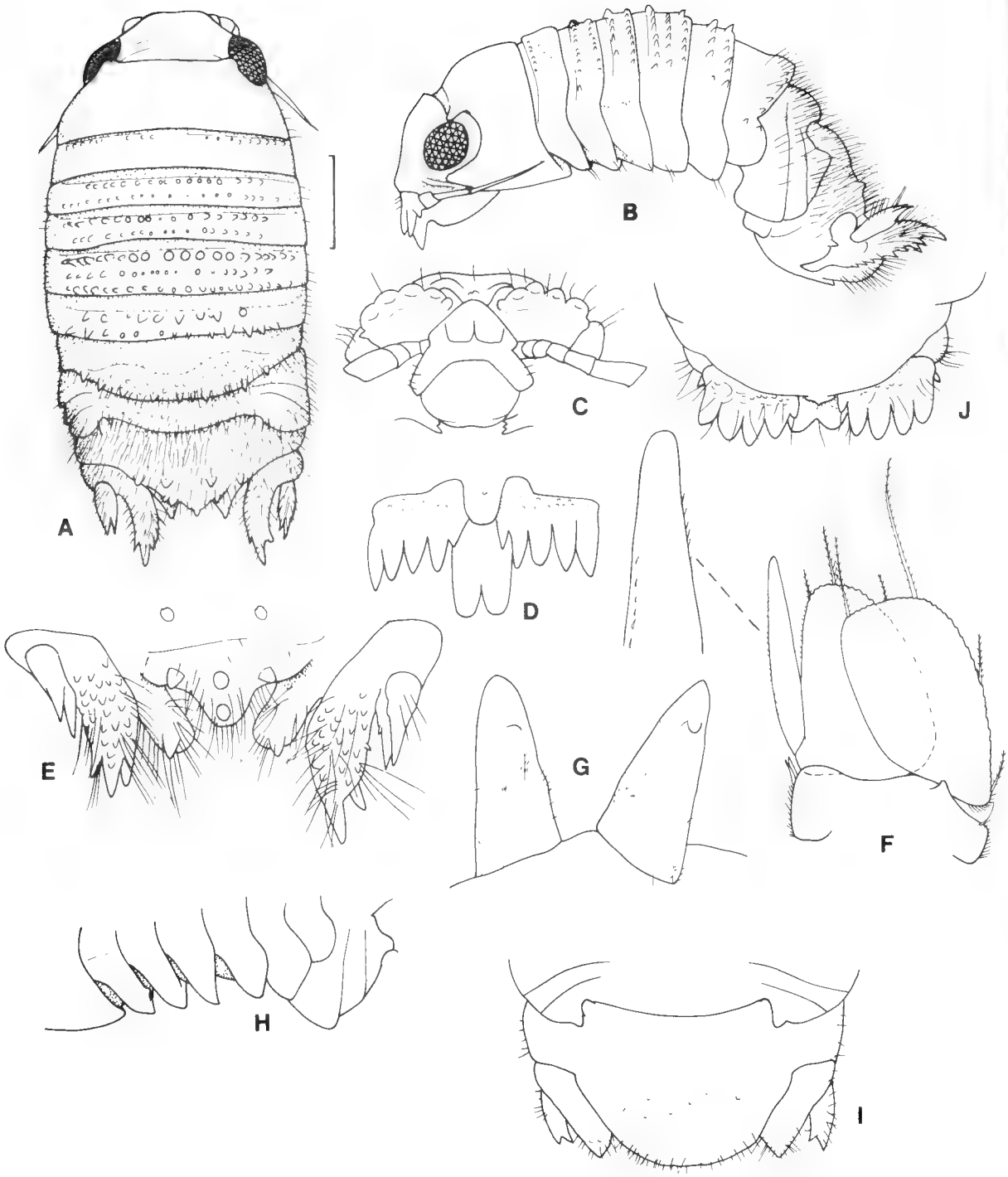


Figure 34. *Oxinasphaera epostoa* sp. nov. A–E, J holotype, G, F♂ 6.0 mm, H, I non-ovigerous ♀ 5.3 mm (both ZMUC CRU1383). A, dorsal view; B, lateral view; C, frons; D, antennules, anterior view; E, pleotelson, posterior margin; F, pleopod 2; G, penes; H, coxae 2–7; I, pleotelson, dorsal view. Scale 1.0 mm.

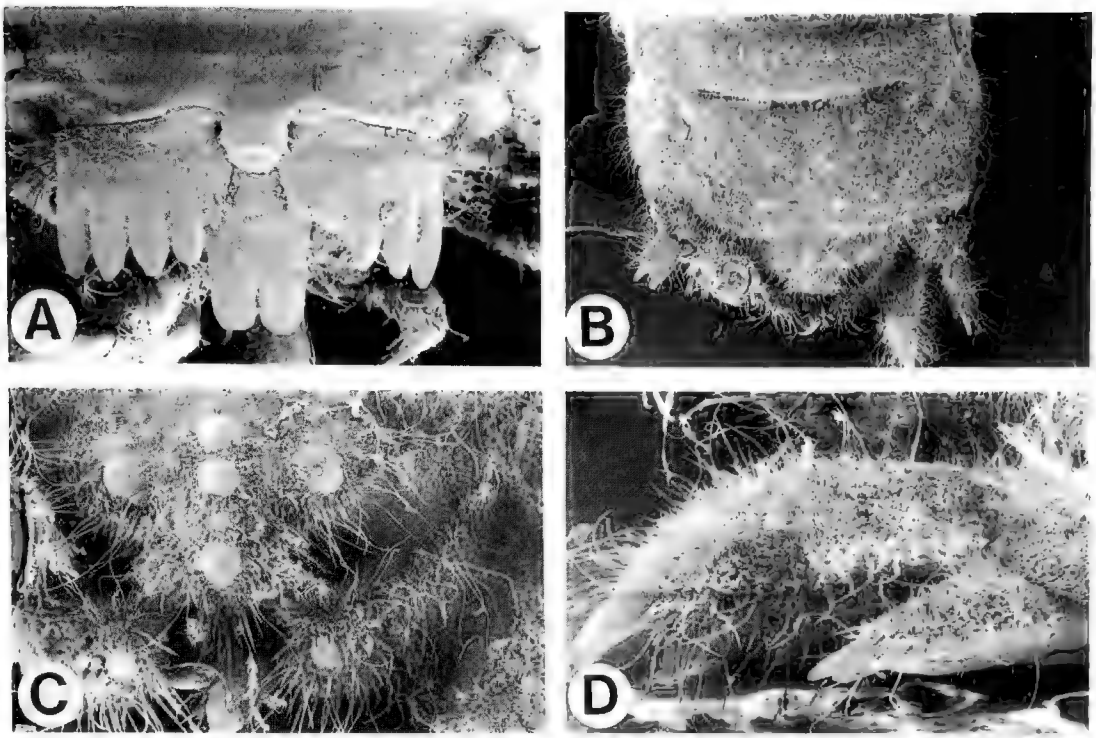


Figure 35.*Oxinasphaera epostoa* sp. nov., SEMs. ♂ 5.3 mm (ZMUC CRU1383). A, cephalon, anterior margin (x75); B, pleon and pleotelson (x30); C, pleotelson apex (x100); D, uropod (x100).

(non-ovig 4.5, 4.7, 4.8, 5.0, 5.3 [drawn] mm), 2 mancas (3.5, 4.3 mm), same data as holotype except, from mixed sponges (ZMUC CRU1383). 21♂ (3.8–6.4 mm, mean = 5.5. mm), 12♀ (9 ovig 3.7–5.3 mm, mean = 4.5 mm, 3 non-ovig), manca (2.5 mm), same data as holotype, except: 7 Aug 1986, 5–7 m, burrowing into sponge, P.J.F. Davie (QM W20033, ZMUC CRU1382).

Non-paratypic material. **NT.** ♂ (6.0 mm), Arafura Sea, NE of Cobourg Peninsula, 11°09′S, 134°27′E, 21 Oct 1989, 30.2 m, BRR (QM W20044). 17♂ (4.4–6.4 mm, mean = 5.5 mm), 4♀ (ovig, all broken, non-ovig 4.8 mm), Arafura Sea, NE of Cobourg Peninsula, 11°27′S, 133°34′E, 18 Oct 1989, 20.1 m, BRR (QM W20042). ♂ , 5♀, Table Head, Port Essington, Cobourg Peninsula, 11°14.4′S, 132°10.8′E, 13 May 1983, 4 m, *Jaspis* sp., N.L. Bruce (NTM Cr0011332).

Description of male. Body about twice as long as greatest width; dorsal surfaces not polished, generally granular, with scattered setae, particularly dense on pleon and pleotelson. Cephalon dorsal surface not nodulose; anterior margin unornamented; rostrum without spike. Pereonite 1 anterior margin with row of fine nodules. Pereonite 2–6 each with 2 transverse rows of prominent spikes, pereonite with additional middle row of low nodules; anterior row largest on pereonite 4, both rows subequal in size on pereonites 3, 4 and 6; pereonite 7 with posterior spikes only; coxae 5 and 6 with posterior margins straight, coxae 7 rounded. Pleon without posterior boss, without prominent spikes. Pleotelson without prominent spikes or acute tubercles; posterolateral flange without acute tubercles; posterior margin with deep groove on either side of distinctly dorsal median lobe; median lobe with prominent rounded median tubercles and adjacent rounded tubercles; telson on either side of apical notch forming distinct lobe, each with prominent spike.

Antennule peduncle article 1 with 4 large and 1 small medial flat anterior spikes; without posterior spikes; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae; flagellum with 8 articles.

Epistome with 2 prominent elongate flat truncate spikes, without subsidiary spikes.

Pereopods as for *O. tuberculosa.*

Penial processes each twice (2.0) as long as basal width, both margins converging evenly to an acute point; proximolateral margins weakly scaled.

Pleopod 1 endopod without lobed or grooved medial margin. Pleopod 2 appendix masculina straight, 7.6 times as long as maximum width,

tapering from about mid-length, longer (1.2) than endopod, extending beyond endopod by about 0.15 of its length, apex bluntly rounded. Uropods as for *O. tuberculosa*.

Female. Not distinguishable from *O. tuberculosa*.

Colour. Pale tan to white in acohol, with scattered chromatophores.

Size. Males 4.5–6.2 mm, females 4.5–5.6 mm.

Remarks. In most characters *Oxinasphaera epostoa* differs little from *O. tuberculosa*. The characters that do distinguish the two species are, in *Oxinasphaera epostoa* the pleon having fewer tubercles and being densely setose, a shorter and rounder median process on the pleotelson, the lateral grooves on posterior of pleon are less clearly defined, coxae 5 and 6 are posteriorly straight (rounded in *O. tuberculosa*), the anterior pereonites are less nodulose, pereonite 7 with only a single row of spikes, the appendix masculina being longer and apically more slender and the penes slightly longer (1.95–2.0 vs 1.87 in *O. tuberculosa*) and less densely set with scale spikes.

Distribution. Cobourg Peninsula, Northern Territory and adjacent Arafura Sea; shallow subtidal to 30 m.

Hosts. *Callyspongia ?diffusa*.

Etymology. *Epostoa* is a genus of woolly cactus.

Oxinasphaera lowryi sp. nov.

Figures 36, 37

Material examined. Holotype, ♂ (8.0 mm), W side Bowen Is., Jervis Bay, NSW, 35°07′S, 150°46′E, 28 Jun 1981, 6 m, from large grey sponge, J.K. Lowry and R.T. Springthorpe (AM P44212).

Paratypes. **NSW**, ♂ (7.9 mm), Wommin reef, S of Cook Is., 28°12.0′S, 153°34.8′E, 4 Feb 1993, 21 m, symbiotic with sponge, J.N.A. Hooper and S. Cook (QM W18423). ♀ (9.5 mm), same data as previous (QM W18427). ♂ (8.5 mm), Julian Rocks, Byron Bay, 28°36.8′S, 153°37.7′E, 2 Feb 1993, 18 m, 'black coral garden', symbiotic with sponge, J.N.A. Hooper and S. Cook (QM W18352). ♂ (8.5 mm, dissected), inside Box Head, Broken Bay, 33°33′S, 151°21′E, 22 Nov 1982, from sponge, J.K. Lowry and R.T. Springthorpe (AM P41154, slides P44217). ♂ (9.2 mm, intermoult), ♀ (non-ovig 6.3 mm), same data as holotype (AM P41159). ♂ (10.0 mm, damaged), Nielsen Park, Sydney, 3 Oct 1979, in *Galeolaria*, N. Svennivig (ZMUC CRU1388).

Description of male. Body about twice as long as greatest width; dorsal surfaces not polished, generally granular, with abundant scattered setae, particularly dense on pleon and pleotelson. Cephalon dorsal surface not nodulose; anterior margin unornamented; rostrum without spike. Pereonite 1 granular, posterior margin with transverse row of fine nodules; pereonite 2 densely granular, with indistinct anterior and posterior nodule rows; pereonites 5 with 3 transverse rows of prominent spikes, pereonite 6 and 7 with single transverse row of widely spaced prominent spikes; coxae 5–7 with posterior margins evenly rounded. Pleon with prominent posterior boss, with prominent posterolateral spikes and 2 spikes set anteriorly to these. Pleotelson densely granular; posterolateral flange with 1 tubercle; posterior margin with deep groove on either side of distinctly dorsal median lobe; telson on either side of apical notch forming distinct lobe; lobes without prominent rounded median tubercles or spikes.

Antennule peduncle article 1 with 4 large flat anterior spikes; without posterior spikes; dorsal surface of peduncular articles 1 and 2 provided with few roughened setae; flagellum with 10 articles.

Epistome with single prominent elongate flat truncate spike.

Pereopod 1 basis about 3 times as long as wide, anterior margin with 2 sensory setae; ischium about 0.7 times as long as basis, about 2.3 times as long as wide, anterior margin with 1 short proximal spines and 1 distal longer and biserrate spine; merus about one-third as long as ischium, about as long as wide, anterolateral angle with 1 long and 1 short spine, posterior margin with 1 spine and single long simple seta; carpus short, about 0.9 times as long as merus, about 0.8 times as long as wide, posterior margin with 2 biserrate spines; propodus about 0.7 times as long as ischium, widest proximally, about 2.7 times as long as wide, posterior margin with 4 large biserrate spines, row of 3 smaller biserrate spines on medial margin; dactylus about half length of propodus. Pereopods 2 similar to 1, differing principally in having the carpus more elongate and propodus more slender and the ischium anterior margin with abundant setules. Pereopod 7 basis about 2.8 times as long as wide, posterior margin with prominent scale spikes, with several sensory setae, anterior margin with abundant long setules; ischium slightly shorter than basis, about 2.7 times as long as wide; merus about half as long as ischium, about 1.8 times as long as wide, posterior margin with

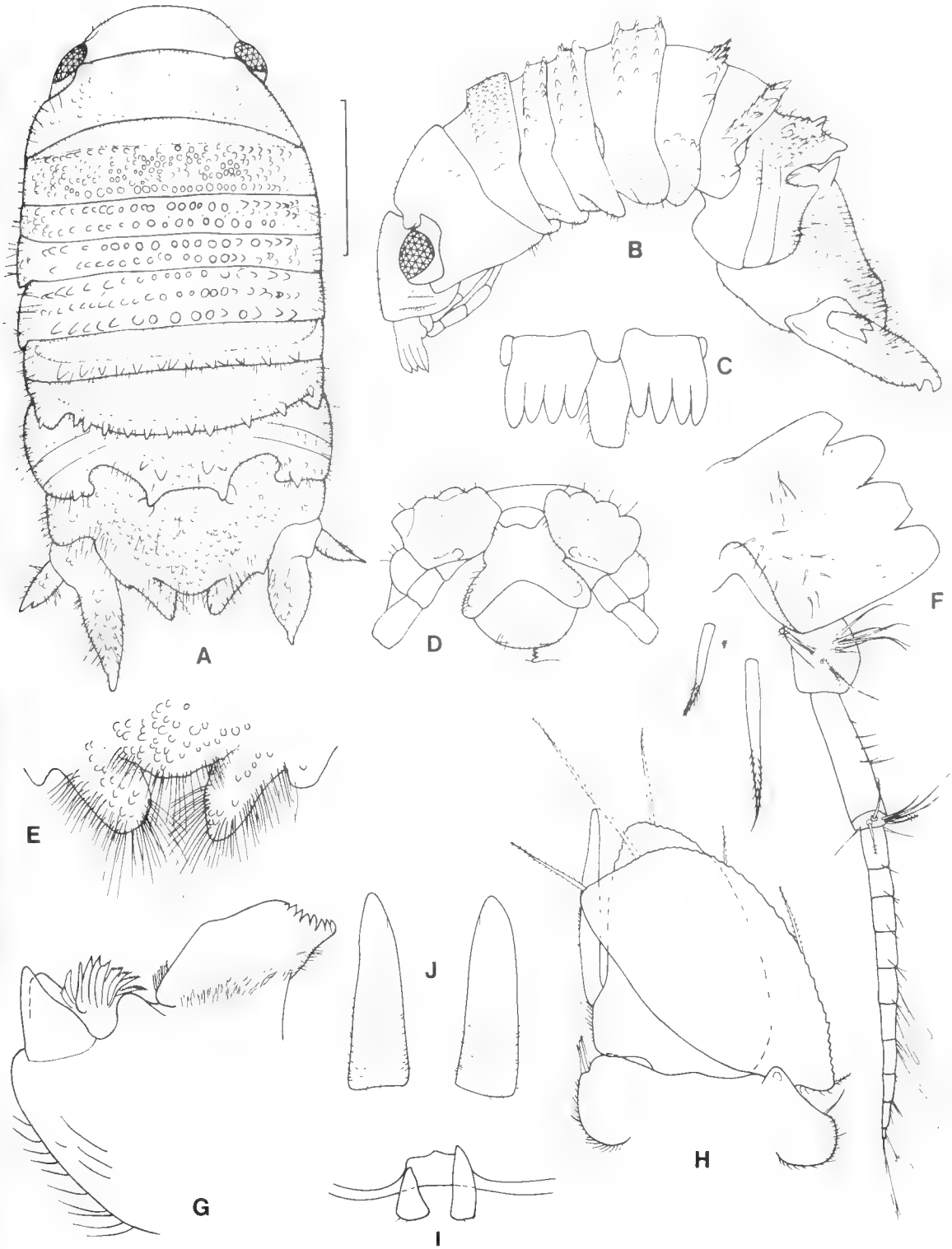


Figure 36. *Oxinasphaera lowryi* sp. nov. A–E holotype, remainder ♂ 8.5 mm (AM P41154). A, dorsal view; B, lateral view; C, antennules, anterior view; D, frons; E, pleotelson posterior margin; F, antennule, f — setae from dorsal surface of pedunular article 1; G, right mandible; H, pleopod 2; I, penes, in situ; J, penes. Scale 2.0 mm.

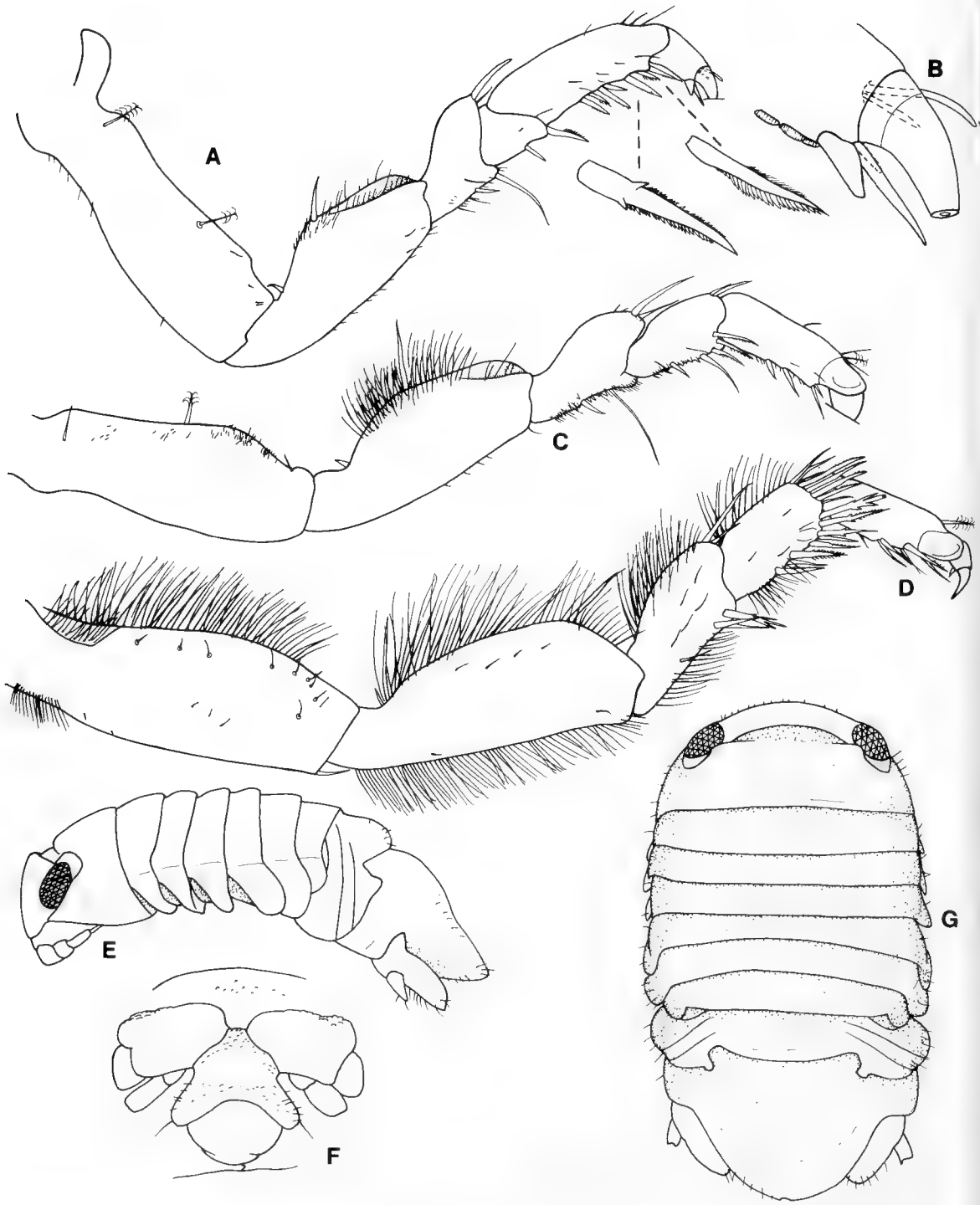


Figure 37. *Oxinasphaera lowryi* sp. nov. A–D, ♂ 8.5 mm (AM P41154), E–G non-ovigerous ♀ 6.3 mm (AM P41159). A, pereopod 1; B, dactylus apex, pereopod 1; C, pereopod 2; D, pereopod 7; E, lateral view; F, frons; G, dorsal view.

3 biserrate and 1 trifid spines, anterodistal angle with 1 large and 1 small spines; carpus about 0.8 times as long as merus, about 1.8 times as long as wide, posterior margin with 5 biserrate spines, distal margin with 2 large trifid spines and 6 biserrate spines, anterodistal margin with 2 weakly serrate spine; ischium to carpus with both anterior and posterior margins with abundant long setules; propodus about 1.3 times as long as carpus and half as long as ischium, about 3 times as long as wide, posterior margin with 6 spines, 2 of which are obviously biserrate, anterodistal angle with 1 sensory seta and 3 simple setae.

Penial processes each about 3 times as long as basal width, medial margin straight, distal lateral margin converging evenly to narrowly rounded point; proximal margins weakly scaled.

Pleopods as for *O. tuberculosa*. Pleopod 2 appendix masculina straight, articulating subbasally, tapering slightly from about mid-length, 9.2 times as long as maximum width, shorter (0.8) than endopod, just extending beyond endopod (by about 0.05 of its length), apex bluntly rounded. Uropod exopod about half as long as endopod, apex deeply bifid with lateral process prominent; endopod about 2.6 times as long as wide, apex with 2 prominent ventrally directed spikes.

Female. Ovigerous females not observed. Non-ovigerous females with distinct pleonal dome, and strongly domed pleotelson; posterior margin of pleotelson with minute median notch.

Colour. In freshly collected preserved, dorsal surfaces densely covered by chromatophores giving an overall dark grey appearance.

Size. Males 7.9–9.5 mm, one non-ovigerous female 6.3 mm.

Remarks. The species, one of the largest of the genus, is immediately recognized by having a single flat epistomal spike, the dorsal surfaces are densely hirsute, on the pereonites the posterior spike rows are prominent and on pereonites 6 and 7 are in a single transverse row. This species is the only species with heavily setulose posterior pereopods.

Distribution. Byron Bay, northern NSW to Jervis Bay, southern NSW (35°S), intertidal to 20 m.

Hosts. Unidentified sponges; also from the massed worm tubes of the polychaete *Galeolaria*, although these could have been from sponges in the tube masses.

Etymology. Named in recognition of Dr Jim K. Lowry's contribution to knowledge of the Australian amphipod fauna.

Oxinasphaera thetisae sp. nov.

Figures 38, 39

Cymodoce tuberculosa. — Whitelegge, 1902: 260, fig. 28, part [non *O. tuberculosa* (Stebbing)].

Material examined. Holotype, ♂ (11.5 mm), 9 km E of Coogee, NSW, 33°57′S, 151°21′E, 15 Mar 1898, 89 m, fine sand, E.R. Waite on HMCS *Thetis* (AM G2270).

Paratypes. NSW. ♂ (1 no head, 9.0, 9.5, 9.7, 10.5 previously dissected, 10.6 mm), ♀ (non-ovig 8.5 mm), 1 km S of Cape Bailey, 34°02.5′S, 151°12.0′E, 11 Mar 1898, 39 m, sand to rock, E.R. Waite on HMCS *Thetis* (AM G2194).

Whitelegge listed the stations from which his specimens were taken as: "8 off Cape Hawke, 10 off Coogee Bay in 25 and 50 fathoms: stns 31 and 44." Material examined here is G2270 from stn 44 and G2194 from stn 36. Other samples identified as *C. tuberculata* in the AM collections are: G2274 (= *O. rebutia* sp. nov. now AM P44206 and *O. bisubula* sp. nov.) from stn 48; G2273 (= *O. bisubula* sp. nov.) from stn 55; G3902 (= *O. bisubula* sp. nov.) from stn 48. Material from stn 31 has not been located.

Description of male. Body about twice as long as greatest width; dorsal surfaces not polished, generally strongly granular, with scattered setae, particularly dense on pleon and pleotelson. Cephalon dorsal surface granular, with anteromedial nodule; anterior margin unornamented; rostrum without spike. Pereonite 1 strongly granular; pereonites 2–7 each with 2 rows of transverse spikes, anterior row prominent, spikes becoming robust on pereonites 5–7 ; coxae 5–7 with posterior margins evenly rounded. Pleon without posterior boss, with 2 prominent submedian spikes on posterior margin, further 5–6 spikes set laterally to these, forming irregular row. Pleotelson densely granular; with 4 submedial clusters of 4 and 3 large spikes; posterolateral flange with 1 acute tubercle; posterior margin with deep groove on either side of distinctly dorsal median lobe; telson on either side of apical notch forming distinct lobe; median lobe with prominent acute or spikes.

Antennule peduncle article 1 with 4–5 irregular flat anterior spikes, lateralmost being prominent; without posterior spikes; dorsal surface of peduncular articles 1 and 2 granular, provided with few roughened setae; flagellum with 14 articles.

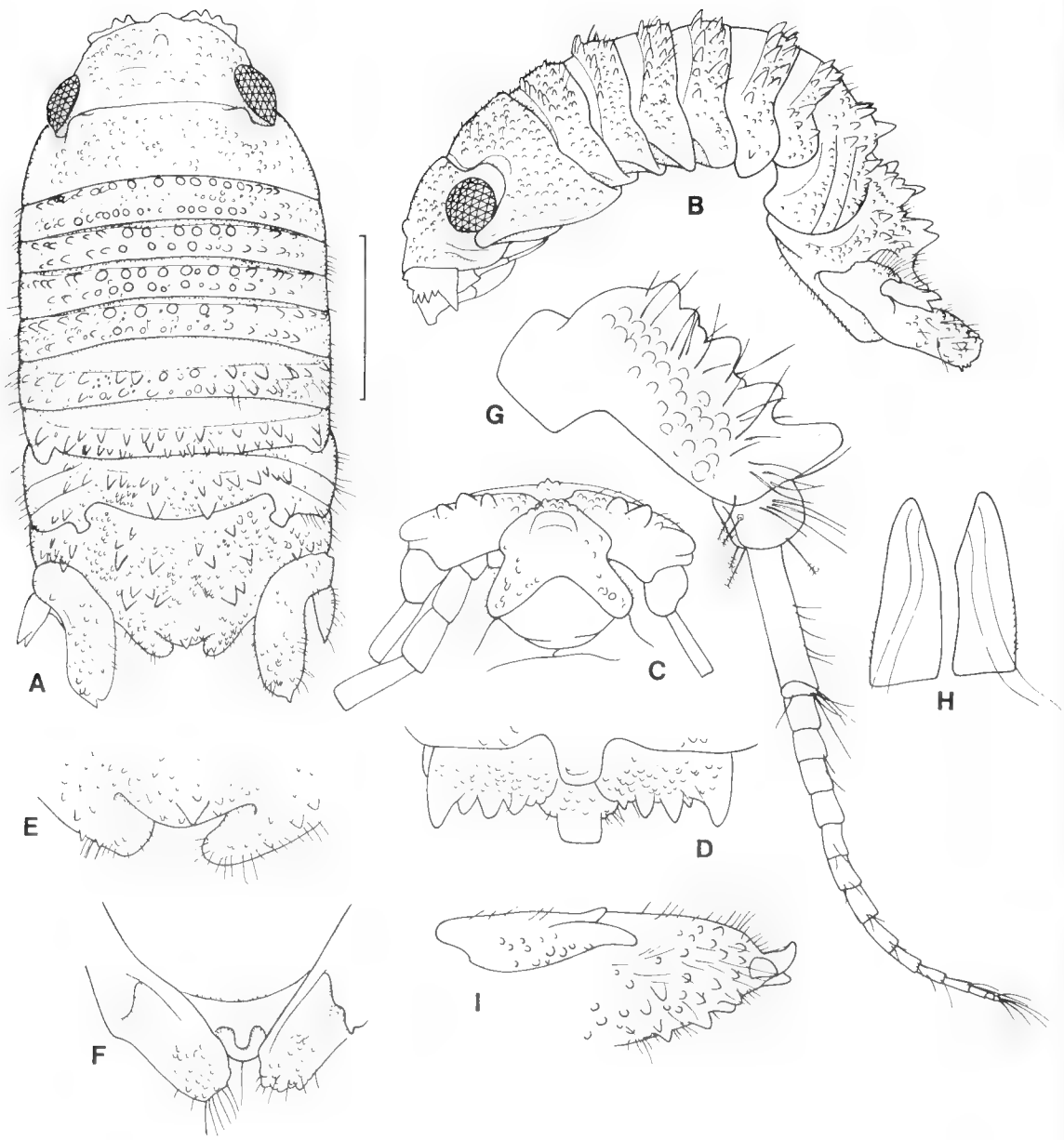


Figure 38. *Oxinasphaera thetisae* sp. nov. A–I holotype, remainder ♂ 9.5 mm (AM G2194). A, dorsal view; B, lateral view; C, frons; D, antennules, anterior view; E, pleotelson posterior margin; F, pleotelson, ventral view of apex; G, antennule; H, penes; I, uropod, in situ. Scale 3.0 mm.

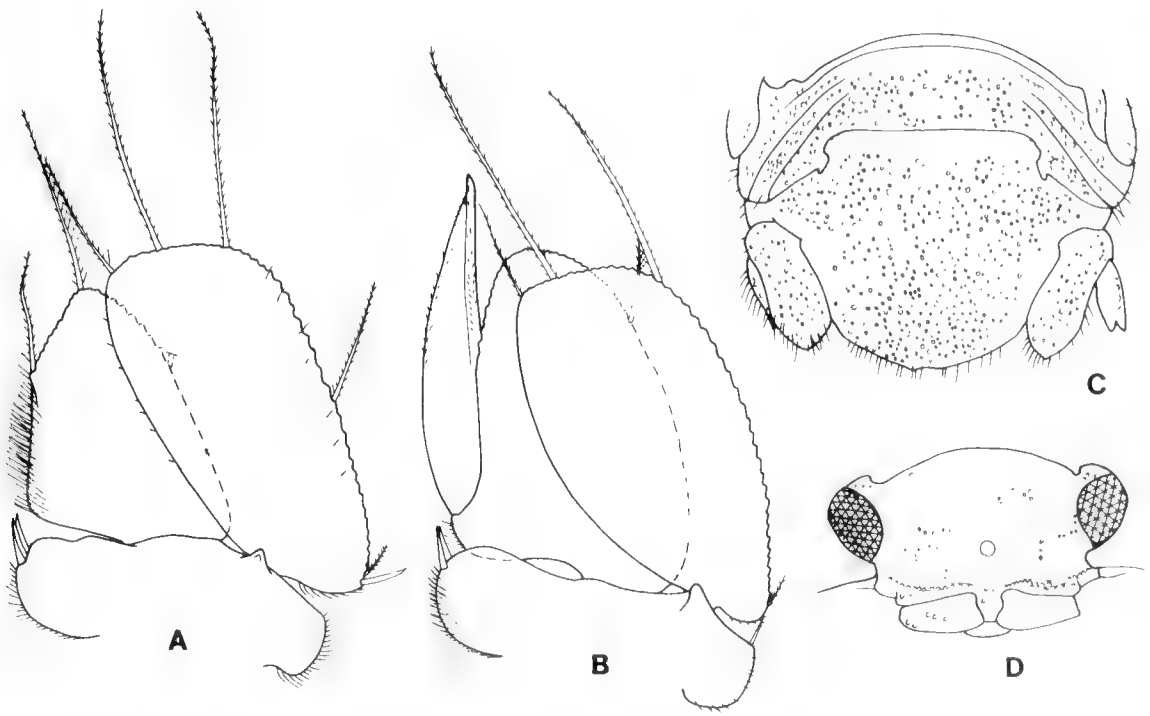


Figure 39. *Oxinasphaera thetisae* sp. nov. A, B, ♂ 9.5 mm, C, D, non-ovigerous ♀ 8.5 (AM G2194). A, pleopod 1; B, Pleopod 2; C, female, pleon and pleotelson; D, female, cephalon, anterior view.

Epistome with single prominent short flat truncate spike.

Pereopods similar to those of others of the group (heavily encrusted, not observed in detail).

Penial processes each about 2.5–3 times as long as basal width, medial margin angling laterally a little beyond midpoint, lateral margin straight, curving medially just before apex; proximolateral margins weakly scaled.

Pleopod 1 endopod two-thirds as long as exopod, proximal margin densely setulose, distal part angle abruptly to medial. Pleopod 2 appendix masculina lateral margin smoothly curved, medial margin straight, articulating subbasally, 5.5 times as long as maximum width, tapering from about mid-length, longer (1.06) than endopod, extending beyond endopod by 0.2 of its length, apex narrow, truncate. Uropod exopod about half as long as endopod, apex deeply bifid with lateral process prominent; endopod about 2.6 times as long as wide, densely granular, apex with 1 prominent and 2 smaller spikes.

Female. The single non-ovigerous female is distinctive in having the dorsal surfaces granular. The posterior margin of the pleotelson is entire.

Colour. Colour has faded from these nearly 100 year old specimens.

Size. Males 9.0–11.5 mm.

Remarks. The identity of Whitelegge's (1902) specimens has always been uncertain, and the material examined here is not identified in the Australian Museum collection as having been identified by Whitelegge, but by Baker as *Cymodoce tuberculata* Stebbing, 1873, presumably a lapsus. Nonetheless, the description given by Whitelegge, particularly of the first antennules and of the size of his specimens, suggests that the present material and Whitelegge's are the one species.

The species is distinctive within the genus in its large size, strongly developed granulosity of the cephalon and pereonite 1, single flat truncate epistomal spike, the robustness of the large pleonal and pleotelson spikes and the irregular antennular spikes. Only *Oxinasphaera lowryi* has a single epistomal spike, but the two species are otherwise dissimilar in appearance, the antennular, pleonal and pleotelson characteristics being widely different.

Distribution. Two stations to the south of Sydney, NSW, circa 34°S, at depths between 39 and 89 m.

Hosts. No host recorded for this species.

Etymology. Named after the research vessel from which the specimens were collected, the HMCS *Thetis*.

Oxinasphaera bispinosa (Baker, 1910) comb. nov.

Figures 40–44

Cymodoce tuberculosa. — Baker, 1908: 140, pl. 3 figs 12–15 (non *Cymodoce tuberculosa* Stebbing, 1873).

Cymodoce tuberculosa n. var. *bispinosa* Baker, 1910: 78, pl. 21 figs 21–23, pl 22 figs 1–7 (part, see comments under 'types') [= *O. bispinosa* (Baker, 1910)].

Material examined. Syntypes (presumed). 3♂ (7.5, 7.0 [head off], 7.0 [in 2 pieces] mm), ♀ (ovig 7.5 mm), "South Australia" (SAM C372).

Non-type material. **Tas.** 400+ ♂ and ♀, subsampled 16♂ (7.0–9.5 mm, mean = 8.2 mm [8.0 SEM, 7.8 SEM dissected). 3♂ (imm 6.0, 6.5, 7.5 mm), 14 ♀ (ovig 6.8, 7.5, 7.7, 8.5 mm, 10 non-ovig 6.0–8.0 mm, mean = 6.9 mm), 28 km E of Cape Farewell, King Is., 39°32.8′S, 144°16.0′E, 1 Nov 1980, 18 m, fine sand, M.F. Gomon and G.C.B. Poore on FV *Sarda* (NMV J26414, 10♂, 10♀ ZMUC CRU1392). 3♂ (6.5, 8.0, 8.5 mm), 47 km E of Cape Rochon, Three Hummock Is., 40°23.8′S, 145°32.0′E, 3 Nov 1980, 66 m, muddy sand, M.F. Gomon and G.C.B. Poore (NMV J26300). 2♂ (7.0, 7.5 mm), 32 km NW of Devonport, 40°56.04′S, 146°39.00′E, 4 Feb 1980, 66 m, muddy sand, M. Gomon and G.C.B. Poore (NMV J26298). 4♂ (6.9, 6.6., 6.3, 5.4 mm), 7♀ (ovig 6.6, 6.3, 6.0, non-ovig 6.6, 6.3, 6.1, 5.7 mm), Isthmus Bay, Bruny Is., 13 Aug 1984, from sponge, J.R. Penprase (TM G2815). 2♂ (7.8, 6.6 mm), ♀ (non-ovig 5.4 mm), near Partridge Is., D'Entrecasteaux Channel, 22 Jul 1957, off sponge on *Mimachlamys asperrimus*, vessel *Te Rapunga* (TM 16682/8445).

Vic. 3♂ (7.0, 7.8, imm 6.2 mm), 82 km SW of Cape Liptrap, 39°06.83′S, 144°49.64′E, 11 Feb 1981, 65 m, medium sand, M.F. Gomon and G.C.B. Poore (NMV J26286).

Additional material. **Tas.** 200+ ♂ and ♀, 35 km E of Cape Farewell, King Is., 39°39.2′S, 144°21.0′E, 1 Nov 1980, 27 m, fine sand, M. Gomon and G.C.B. Poore on FV *Sarda* (NMV J26415). 2♂, 22♀ and mancas (possibly mixed species), 35 km N of Cape Wickham, King Is., 39°13.6′S, 143°55.6′E, 23 Nov 1981, 85 m, fine sand, R. Wilson (NMV J26305). 3♂, 2 ovig♀, 59 non ovig ♀ and imm ♂ , 5 km N of North Point, 40°40.3′S, 145°15.0′E, 4 Nov 1980, 33 m, medium shell, M.F. Gomon and G.C.B. Poore (NMV J26255). 3♂ (1 imm), 39 km NNE of Devenport, 40°49.75′S, 146°31.33′E, 4 Feb 1980, 68 m, mud with bryozoa and sponges, M. Gomon, G.C.B. Poore and C.C. Lu (NMV J40492). 6♂ (3 imm), 11♀ (2 ovig), 2.5 km SE of Birches Bay, D'Entrecasteaux Channel, 43°11.00′S, 147°16.00′E, 16 Apr 1985, 10 m, R.S. Wilson (NMV J40479).

Australian Museum Old Collections. 3♂, NSW, from a sponge [det. as *C. tuberculosa* by Baker, 1926] (AM P9554). 7♂, 8♀, between Merimbula and Tathra, NSW, 18 Jul 1925, 73 m, taken from sponge, W. Boardman on trawler *Bar-Ea-Mul* [det. as *C. tuberculosa* by Baker, 1926] (AM P9564). ♂, Oyster Bay, Tasmania, 42°40′S, 148°03′E, sorted from a bottle of weed washings, FIS *Endeavour* Expedition 1909–14 (AM E6610). ♂, eastern slope Bass Strait, 6 Sep 1930, Endeavour (AM E6753). ♂, 16 km N of Circular Head, Tasmania, FIS *Endeavour* Expedition 1909–14 (AM E6739). ♂, Spencer Gulf, South Australia, 29 m, FIS *Endeavour* Expedition 1909–14 (AM E6770).

Types. The locality was given by Baker (1910) only as "South Australian coast", and I have not been able to identify with absolute certainty the specimens mentioned by Baker, which would be the syntypes of this species. The South Australian Museum has two samples determined by Baker as *Cymodoce tuberculosa* var *bispinosa*. One of these (SAM C372, labelled "syntypes") contains three males and an ovigerous female of *O. bispinosa*. The other (SAM C371, also labelled "syntypes") contains two specimens of *Cymodoce tuberculosa* Stebbing, 1873 and two specimens of a large species of uncertain generic disposition. Another sample exists (SAM C369) which is identified as *Cymodoce tuberculosa*, but these five females do not appear to be *Cymodoce tuberculosa*, and furthermore are not a species of *Oxinasphaera*, and appear most similar to the genus *Neosphaeroma* Baker, 1926. Baker (1910) unfortunately failed to make clear on which specimens he was basing his description, and the sample SAM C372 is here taken to be the presumed syntypes. Owing to the uncertain type status of SAM C372, a lectotype has not been selected.

Description of male (based on material from Cape Farewell, Tasmania, NMV J26414). Cephalon with dorsal median nodule; anterior margin without nodules; with prominent bifurcate rostral point. Pereonite 1 with obscure longitudinal grooves on lateral surfaces, otherwise without tubercles or ornamentation. Pereonites 2 and 3 each with 2 transverse rows of distinct low spikes, pereonites 4–7 each with 2 transverse rows of prominent acute spikes, anterior row larger than posterior row on 4 and 7, subequal on 5 and 6; coxae 5 and 7 with posterior margins evenly rounded, coxae of pereonite 6 posteriorly straight. Pleon posterior boss with 2 submedian prominent processes extending posteriorly over pleotelson, proximally well separated, pleon otherwise without prominent spikes. Pleotelson with 2 prominent spikes opposing those of pleon, posterior margin with two prominent submedian indentations either side of median lobe .

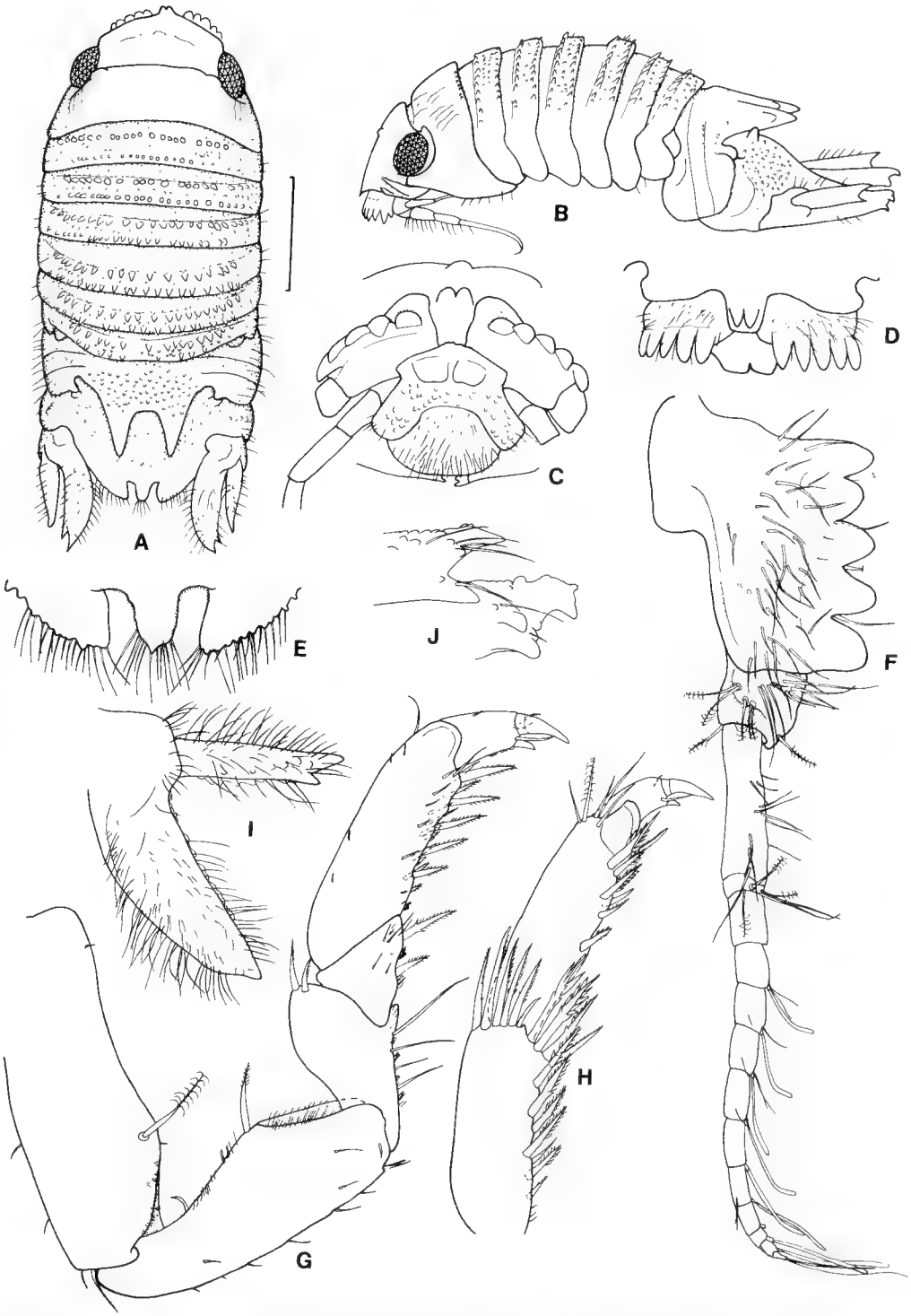


Figure 40. *Oxinasphaera bispinosa* (Baker). ♂ 8.5 mm (NMV J26414). A, dorsal view; B, lateral view; C, frons; D, antennules, anterior view; E, pleotelson apex; F, antennule; G, pereopod 1; H, pereopod 7, distal articles; I, uropod; J, uropod apices, lateral view. Scale 2.0 mm.

Figure 41. *Oxinasphaera bispinosa* (Baker), ♂ 8.5 mm (NMV J26414). A, maxilliped; B, pleopod 1; C, pleopod 2; D, appendix masculina apex; E, penes.

Antennule peduncle article 1 with 5 broadly rounded anterior spikes; without posterior spikes; flagellum with 12 articles.

Epistome with 2 prominent narrowly separated flat distally truncate spikes. Mandible molar process distal margin deeply indented.

Pereopod 1 basis about 2.6 times as long as wide, anterior margin with 1 sensory setae; ischium about 0.9 times as long as basis, about 2.7 times as long as wide, anterior margin with 1 short proximal spines and 1 distal longer and biserrate spine; merus about 0.4 times as long as ischium, about 1.2 times as long as wide, anterolateral angle with 2 gently curving pectinate spines, posterior margin with 4 long setae; carpus short, about 0.4 times as long as merus, about 1.3 times as long as wide, posterior margin with 2 biserrate spines; propodus about 0.8 times as long as ischium, widest proximally, about 3.2 times as long as wide, posterior margin with distinct scale spikes and 5 large biserrate spines, row of 9 smaller biserrate spines on medial margin; dactylus about 0.4 length of propodus, unguis about 47% length of entire dactylus. Pereopod 7 carpus about 2.3 times as long as wide, posterior margin with 6 biserrate spines, 3

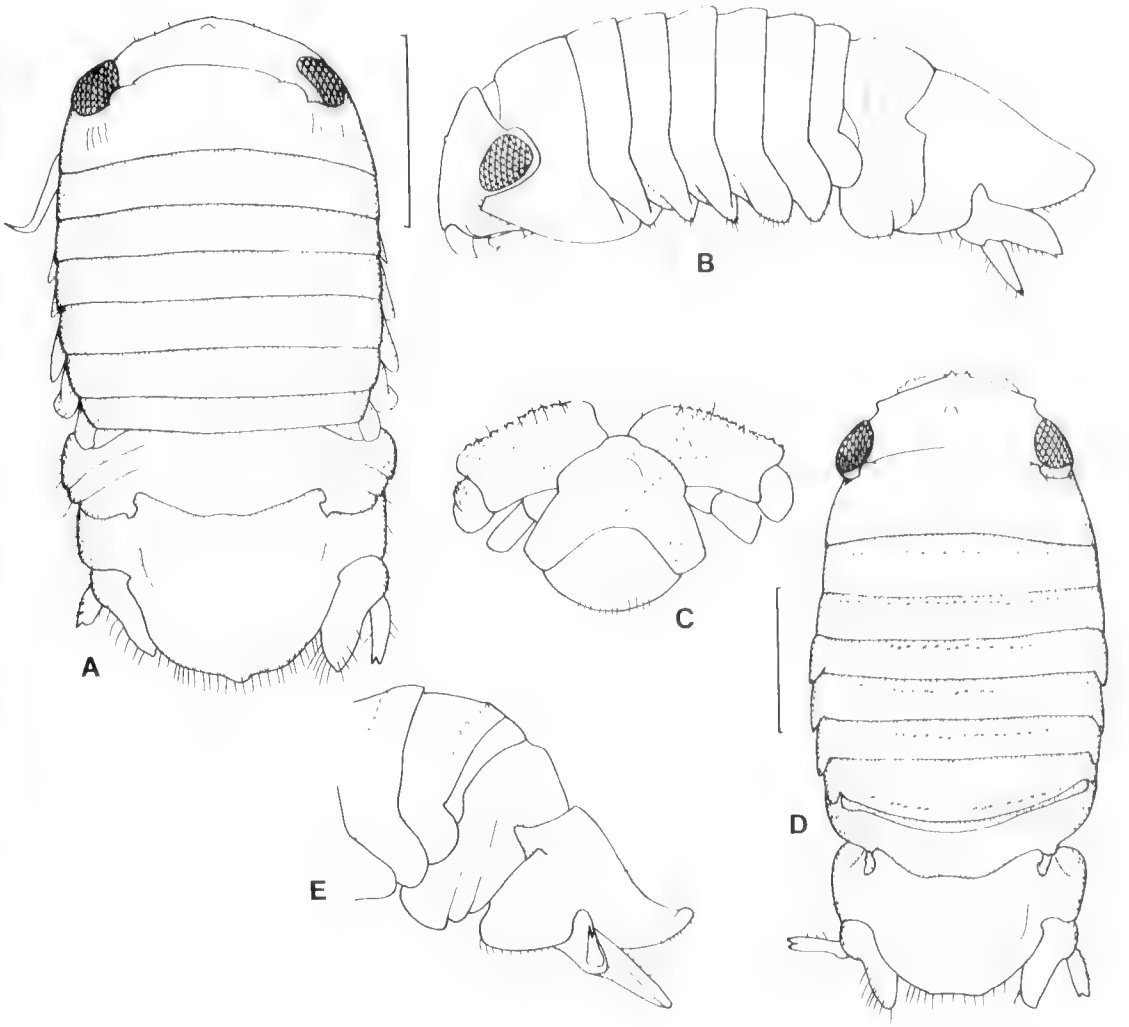


Figure 42. *Oxinasphaera bispinosa* (Baker), A–C, non-ovigerous ♀, 7.0 mm, D, E ovigerous ♀, 8.5 mm. A, dorsal view; B, lateral view; C, frons; D, dorsal view; E, pleon and pleotelson, lateral view. Scale 2.0 mm.

biserrate spines on posteromedial margin, distal margin with 2 large trifid spines and 6 biserrate spines; propodus about 1.2 times as long as carpus and about 2.6 times as long as wide, posterior margin with 7 biserrate spines, anterodistal angle with 4 simple and 1 sensory setae.

Penial processes each about 6.7 times as long as basal width, tapering to an elongate narrowly rounded apex, extending to pleopod rami; distal one third of penial process with plane twisted 90 to proximal part; proximolateral margin with scale spikes.

Pleopod 1 exopod with ventral lateral submarginal groove. Pleopod 2 appendix masculina basal two thirds swollen, distal third narrow, 4.3 times as long as maximum width, apex bluntly truncated. Uropod dorsally nodular, covered with roughened setae; exopod about 4.6 times as long as proximal width, about 0.6 times as long as endopod, apex deeply bifid with lateral process prominent; endopod about 3.7 times as long as wide, apex with prominent point and, in lateral view, 2 prominent downwardly projecting spikes.

Ovigerous Female. Cephalon with median dorsal tubercle; pereonites 2–7 each with single row of indistinct low tubercles; pleon smooth, without nodules or domes; pleotelson posterior margin with wide median excavation.

Non-ovigerous Female. Cephalon with median dorsal tubercle. Body smooth, finely granular,

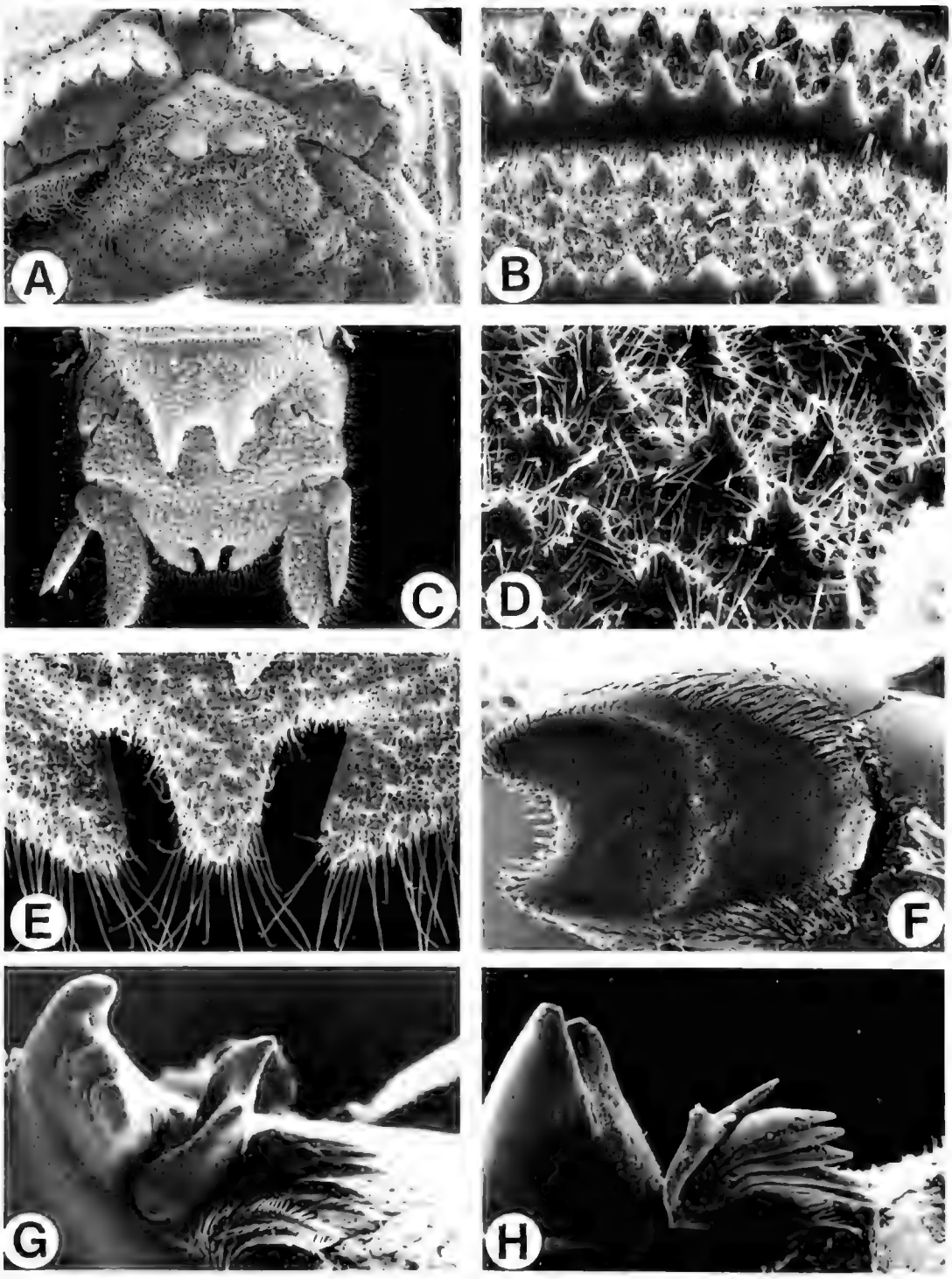


Figure 43. *Oxinasphaera hispinosa* (Baker), SEMs. A–E ♂ 7.8 mm, G, H, ♂ 7.5 mm (NMV J26414). A, frons (×65); B, spike rows, pereomites 5 and 6 (×110); C, pleon and pleotelson (×22); D, pleotelson, tubercles and pits (×400); E, pleotelson apex (×130); F, molar process (×300); G, left mandible, incisor, lacinia mobilis and spine row (×430); H, right mandible, incisor and spine row (×500).

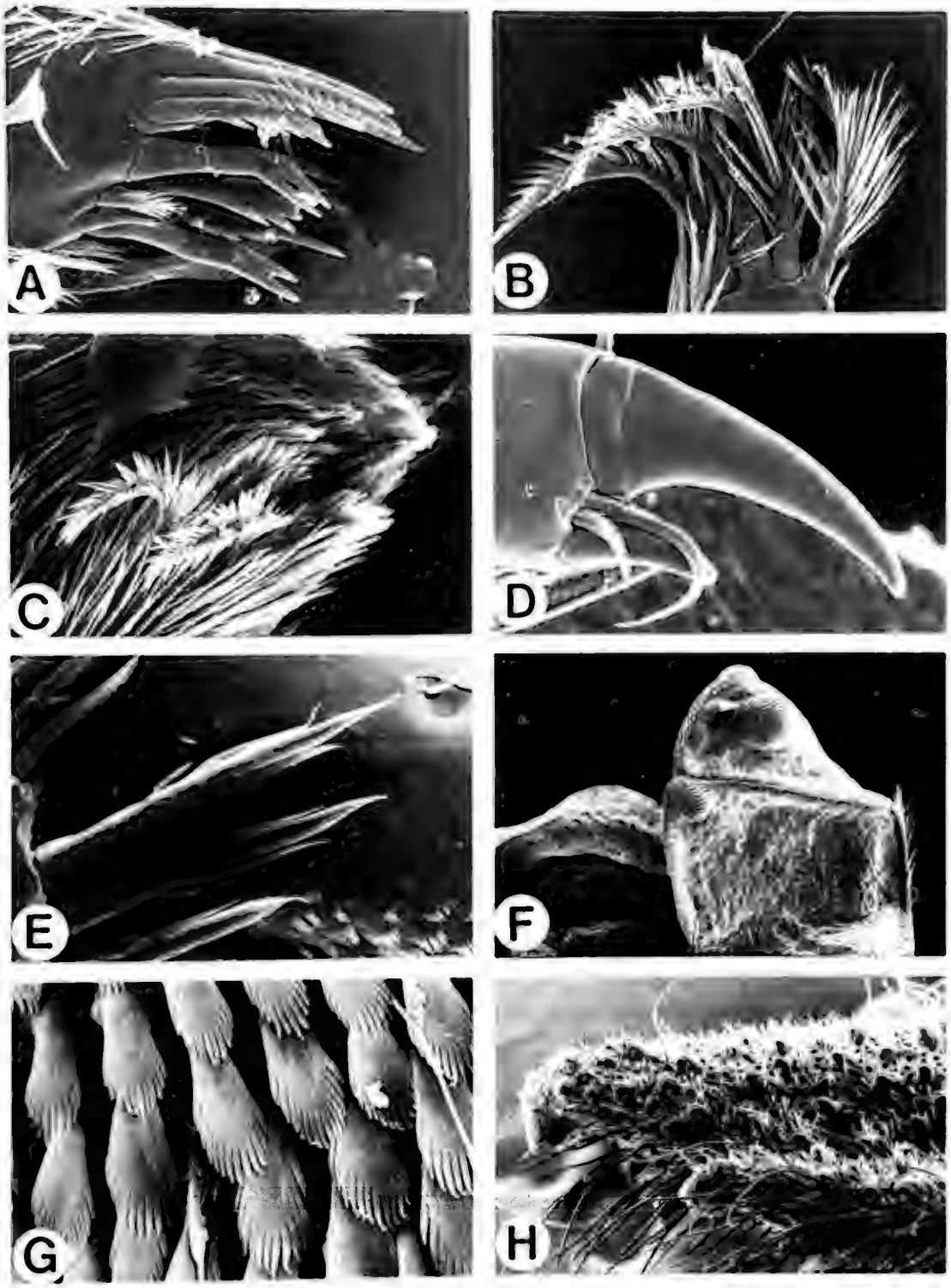


Figure 44. *Oxinasphaera bispinosa* (Baker). SEMs. ♂ 7.5 mm (NMV J26414). A, maxillule, lateral lobe (×500); B, maxillule, medial lobe (×430); C, maxilliped endite, dorsal surface showing serrate spines (×430); D, pereopod 1, unguis, distal spine and setae (×650); E, pereopod 7, trifid spines on carpus (×450); F, pleopod 5 (×150); G, scale from scale lobe, pleopod 5 (×3000); uropod, distal ends of rami (×170).

unornamented. Epistome with rudimentary undivided flat spike.

Colour. Pale yellow ground colour, usually without chromatophores. Cuticle usually opaque.

Size. Males 5.4–9.5 mm, immature males 6.0–7.5 mm, females 5.7–8.0 mm, ovigerous females 6.0–8.5 mm.

Remarks. The lack of material from further west than the east Victorian coast, and the evident south-eastern distribution of the recent records, suggests that Baker's data may be incorrect. As there is no fresh or recent material from the South Australia coast, the redescription is here based on the large sample of specimens from off Tasmania's northern coast (NMV J26414).

Oxinasphaera bispinosa is one of the most easily recognised species of the genus, and is the only Australian species with prominent pleonal processes. It is further distinguished by the elongate penial processes and bottle-shaped appendix masculina. It shares all of these characters with *Oxinasphaera tripartita* from Papua New Guinea and the Philippines and *Oxinasphaera kensleyi* sp. nov, from South Africa. It can be separated from those two species by the different shape of the processes, the regular antennular spikes and by lacking a large prominent pleotelsonic lobe overriding the pleotelsonic apex.

Distribution. All recent material is from around Tasmania and the Bass Strait, from about 39° to 43°S and westwards to 147°E, at depths between 18 and 85 metres. Substrata recorded are fine sand, and medium shell. Old material includes one lot from Spencer Gulf, S.A, collected by F.I.S. *Endevour* in 1909–1914, and one sample taken off the coast between Tathra and Merimbula, NSW, in 1925.

Hosts. Some records are from sponges, none identified.

Etymology. The epithet given by Baker presumably alludes to the prominent pleonal processes.

Oxinasphaera tripartita
(Richardson, 1910) comb nov.

Figures 45–47

Cymodoce tripartita Richardson, 1910: 29, fig. 27.

Non *Cymodoce tuberculosa tripartita.* — Barnard, 1920: 363, pl. 15 fig. 28. — Barnard, 1940: 504. — Nierstrasz, 1931: 200. — Kensley, 1978: 100, fig. 42C (= *Oxinasphaera kensleyi* sp. nov.).

Material examined. Syntype, ♂ (3.4), Jolo Jolo, Philippines, 11 Feb 1908, from interior of a pearl oyster (USNM 40919) [See 'Remarks'].

Non-type material, 4♂ (3.4, 3.3, 3.3, 3.2 mm), 5♀ (2.3, 2.6, 2.6, 2.7, 2.8, 2.8 mm), between Kranket Is and Paenwai Is, Madang, Papua New Guinea, 5°11.2'S, 145°50.9'E, 22 May 1989, 20 m, from sponge, N.L. Bruce and M. Jebb (ZMUC CRU1393).

Description of male (based on Madang specimens). Body about twice as long as wide, cuticle clear. Cephalon anterior half irregularly and finely nodulose; anterior margin without nodules; with very weak obscure bifurcate rostral spike. Pereonite 1 unornamented. Pereonites 2 and 3 each with 2 transverse rows of distinct low spikes, pereonites 4–7 each with 2 transverse rows of prominent acute spikes, anterior row larger than posterior row on 4 and 5, posterior row largest on pereonite 7; coxae 5 and 6 posterior margins straight, those of pereonite 7 posteriorly rounded. Pleon posterior boss, with 2 submedian prominent processes extending posteriorly over pleotelson, medial separating margin concave. Pleotelson dorsal surfaces conspicuously granular; with 2 prominent spikes opposing those of pleon; lateral flange with 1 prominent spike; posterior margin with prominent posteriorly rounded lobe overlying telsonic excision and extending posterior to submedian indentations.

Antennule peduncle article 1 with 7–8 irregular anterior spikes and posteromedial blade; flagellum with 4 articles.

Epistome without distinct spikes, with indistinct transverse blade armed with irregular small tubercles.

Pereopod 1 basis about 3 times as long as wide, anterior margin with 2 sensory setae; ischium 0.7 times as long as basis, 2.6 times as long as wide, anterior margin with 1 short proximal spines and 1 distal longer and biserrate spine; merus about 0.4 times as long as ischium, about 1.3 times as long as wide, anterolateral angle with 1 gently curving pectinate spine, posterior margin with 1 long seta; carpus short, about 0.8 times as long as merus, about 1.3 times as long as wide, posterior margin with 2 biserrate spines; propodus about 0.8 times as long as ischium, widest proximally, about 2.8 times as long as wide, posterior margin with distinct scale spikes and 4 large biserrate spines, row of 3 smaller biserrate spines on medial margin; dactylus about 0.5 length of propodus, unguis about

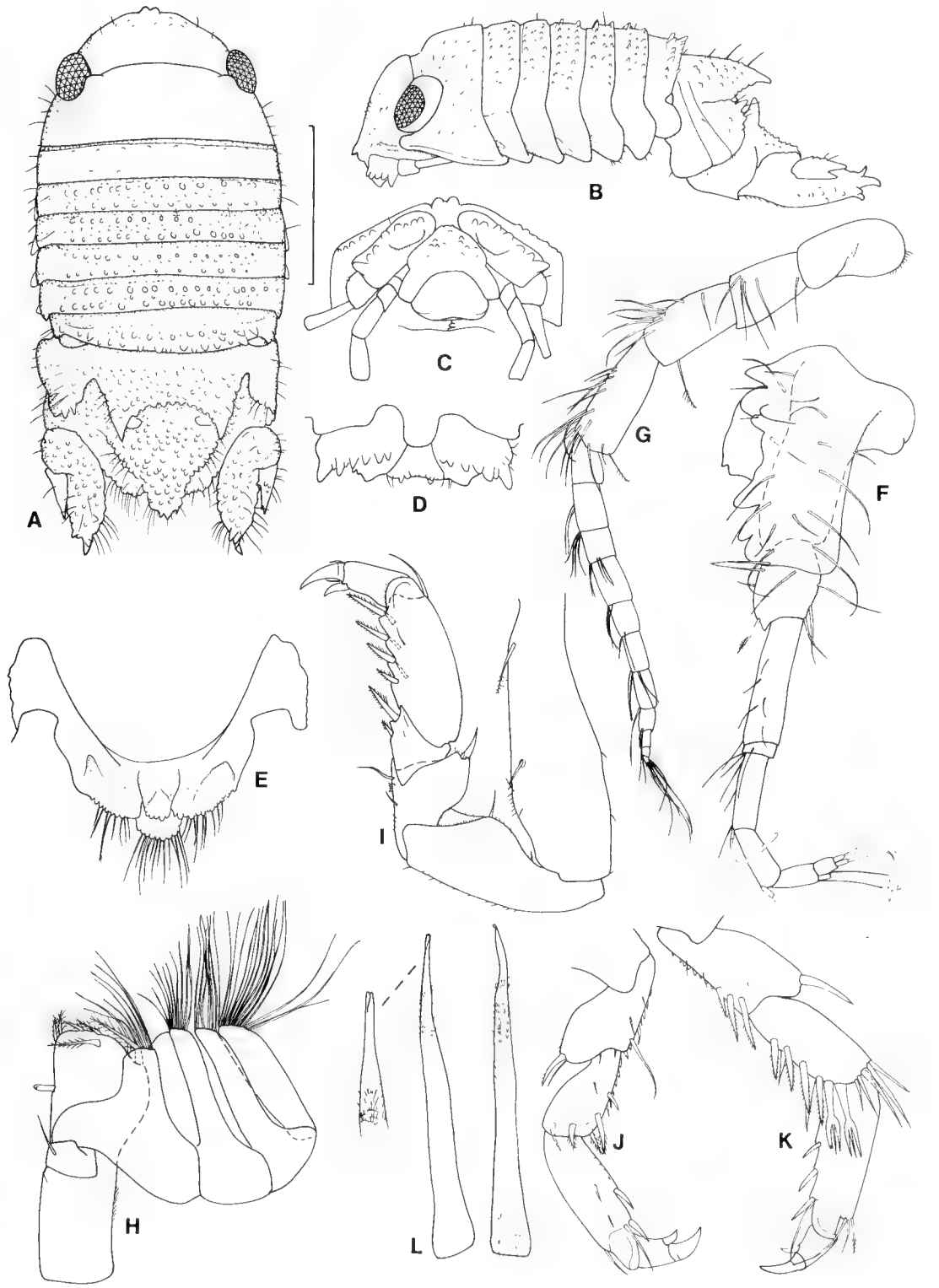


Figure 45. *Oxinasphaera tripartita* (Richardson). A–E ♂ 3.3 mm, remainder ♂ 3.2 mm (ZMUC CRU1393). A, dorsal view; B, lateral view; C, frons; D, antennules, anterior view, in situ; E, pleon, ventral view; F, antennule; G, antenna; H, maxilliped; I, pereopod 1; J, pereopod 2, distal articles; K, pereopod 7, distal articles; L, penes. Scale 1.0 mm.

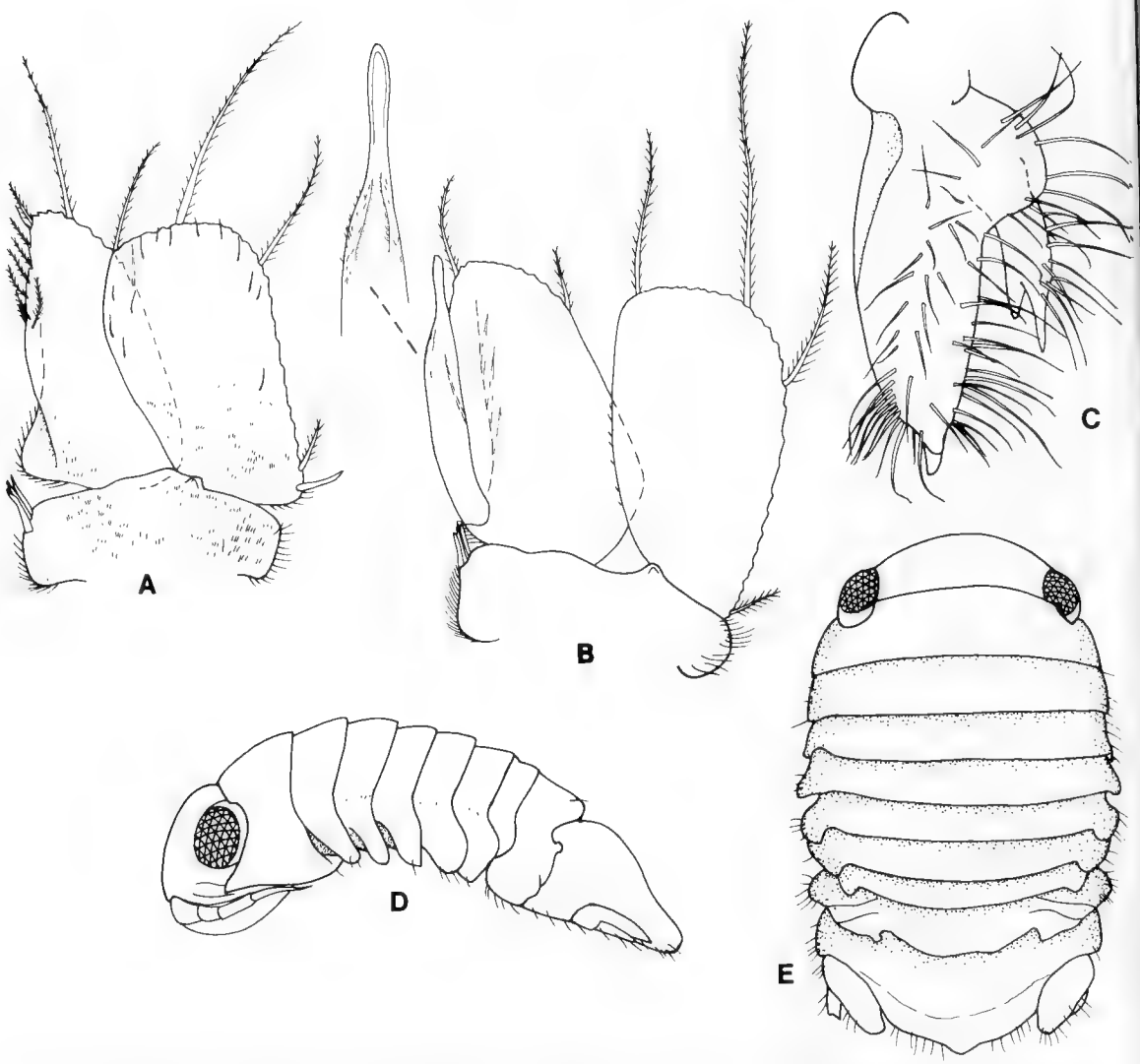


Figure 46. *Oxinasphaera tripartita* (Richardson). A–C ♂ 3.2 mm, D, E non-ovigerous ♀ 2.8 mm (ZMUC CRU1393). A, pleopod 1; B. pleopod 2; C, uropod; D, lateral view; E, dorsal view.

52% length of entire dactylus. Pereopod 7 carpus about 2.3 times as long as wide, posterior margin with 4 biserrate spines and 2 weakly biserrate spines, distal margin with 2 large trifid spines and 5 simple or very weakly biserrate spines; propodus 1.3 times as long as carpus and 3.1 times as long as wide, posterior margin with 3 spines, anterodistal angle with 2 simple and 1 sensory setae.

Penial processes each about 7.5 times as long as basal width, tapering to an elongate slender apex, extending to pleopod rami; proximolateral margin with scale spikes, distal margin with scale setules.

Pleopod 1 exopod with ventral lateral submarginal groove. Pleopod 2 appendix masculina basal four-fifths swollen, distal fifth narrow, apex obliquely truncated, 7.3 times as long as maximum width. Uropod not distinctly nodular, setae smooth; exopod 4.2 times as long as proximal width, about half as long as endopod, apex deeply bifid with lateral process prominent; endopod 3.2 times as long as wide, apex with prominent point and 1 prominent downwardly projecting spike.

Female. Pleon and pleotelson without distinct domes; posterior margin of pleotelson with apical triangular protrusion.

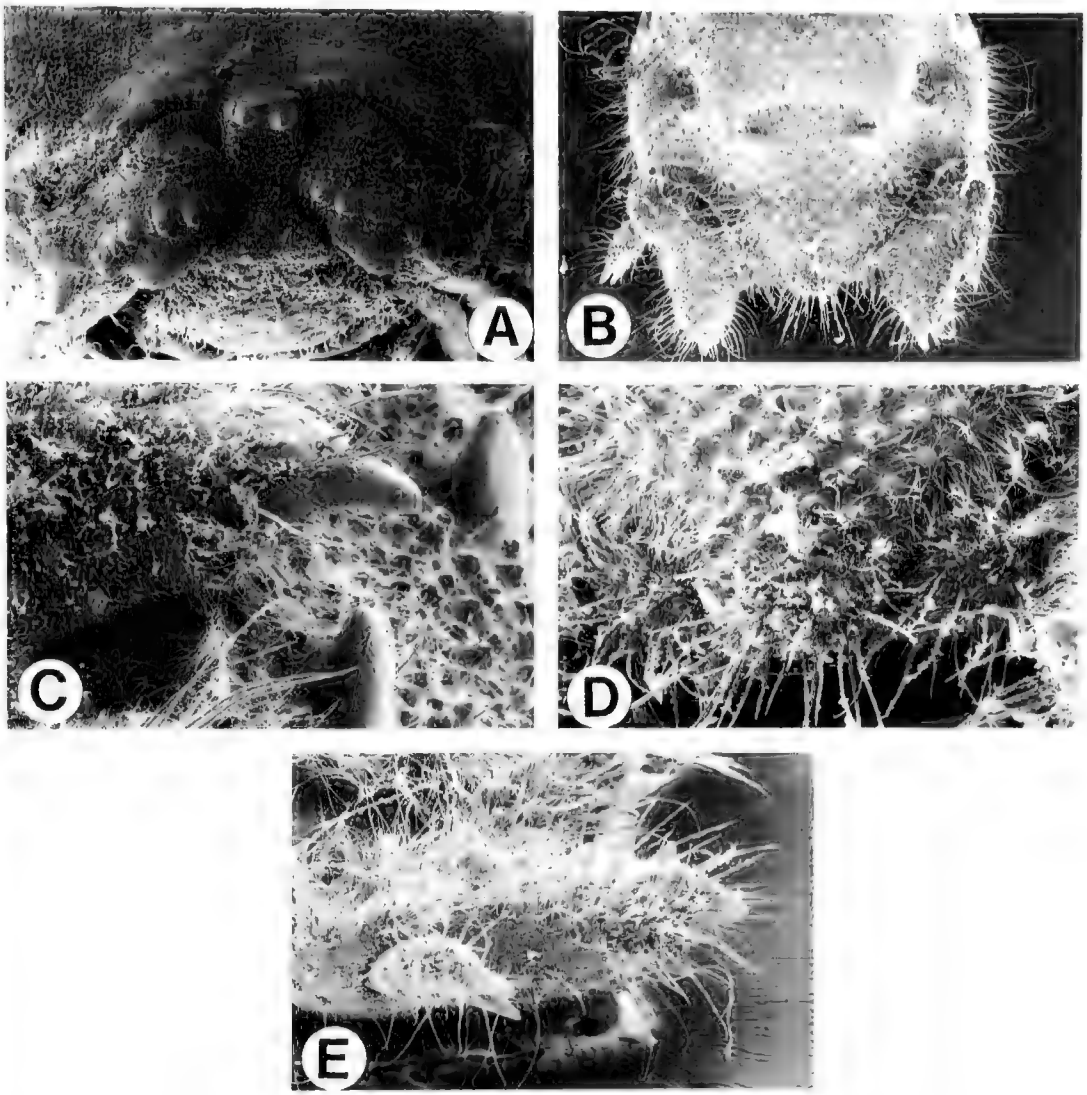


Figure 47. *Oxinasphaera tripartita* (Richardson). SEMs. ♂ 3.3 mm (ZMUC CRU1393). A, frons (×130); B, pleon and pleotelson (×55); C, pleonal and pleotelson spikes, lateral view (×190); D, pleotelson apex (×100); E, uropod rami (×130).

Colour. Pale yellow ground colour, with abundant dark brown chromatophores. Cuticle usually clear.

Size. Males 3.2–3.4 mm, females 2.3–2.8 mm.

Remarks. Richardson (1910) recorded two male and two female syntypes. The present type material consists only of one male. This male is labelled lectotype, but I am unaware of any publication of a lectotype designation, and the specimen is here regarded as a syntype. Richardson recorded this specimen as having been collected from the interior of a pearl oyster, but the vial in which the specimen is contained was found, on examination, to be full of sponge spicules, suggesting that the actual habitat is in sponges.

Two species of *Oxinasphaera*, *O. tripartita* and *O. kensleyi* have a posterodorsal lobe on the posterior margin of the pleotelson in conjunction with antennular peduncle article 1 having an irregular row of anterior spikes and a posteromedial blade. Both species have in addition prominent posteriorly directed processes on the pleon, a character shared with the otherwise dissimilar *O. bispinosa*. *O. tripartita* can be distinguished from *O. kensleyi* by having pereonites 2 and 3 weakly ornamented, the pereonal

spikes of all pereonites being less strongly developed than those of *O. kensleyi*, by having weaker antennular spikes, a wider posterior antennular blade, and the penes and appendix masculina being straight rather than sinuate.

Distribution. Jolo, Philippines and Madang, Papua New Guinea.

Hosts. The specimens from Madang, were collected directly from a sponge, probably a species of *Cribrochalina*.

Etymology. The epithet given by Richardson presumably alludes to the prominent pleonal processes.

Oxinasphaera kensleyi sp. nov.

Figures 48, 49

Cymodoce tuberculosa tripartita. — Barnard, 1920: 363, pl. 15 fig. 28. — Barnard, 1940: 504. — Nierstrasz, 1931: 200. — Kensley, 1978:100, fig. 42C.

Cymodoce tuberculosa-Kensley, 1984: 216.

Non *Cymodoce tuberculosa* Stebbing, 1873: 96, pl. 3 figs 1, 1b.

Non *Cymodoce tripartita* Richardson, 1910:29, fig. 27.

Material examined. Holotype, ♂ (4.3 mm), off East London, South Africa, 33°04.6′S, 28°06.6′E, 26 May 1978, 90 m, stn 163, R.V. *Meiring Naude* (SAfM A41309).

Paratypes. 5♂ (3.9, 4.0 [dissected], 4.1, 4.2, 4.5 mm), same data as holotype (SAfM A19308).

Description of male. Cephalon anterior half irregularly and finely nodulose, with low median tubercle; anterior margin with row of small close-set nodules; with weak obscure bifurcate rostral spike. Pereonite 1 with anterior submarginal transverse row of small tubercles. Pereonites 2 -7 each with 2 transverse rows of acute spikes, those of pereonites 2–4 being somewhat rounded, anterior row larger than posterior row; coxae 5–7 posterior margins rounded. Pleon posterior boss with 2 submedian prominent processes extending posteriorly over pleotelson, each process with prominent proximal ventral spike, medial separating margin straight. Pleotelson dorsal surfaces conspicuously granular; with 2 prominent bluntly rounded spikes opposing those of pleon; lateral flange weakly developed, with 1 prominent spike; posterior margin with prominent posteriorly acute lobe overlying telsonic excision and extending posterior to submedian indentations.

Antennule peduncle article 1 with 5 irregular anterior spikes, distal most being most prominent, with distally truncate posteromedial blade; flagellum with 6 articles.

Epistome without distinct spikes, with indistinct transverse blade armed with irregular small tubercles.

Pereopod generally similar to those of *O. tripartita*.

Penial processes 7.2 times as long as basal width, tapering to an elongate slender acute apex, extending to pleopod rami; proximolateral margin with scale spikes, distal medial margin with scale setules.

Pleopod 1 exopod with ventral lateral submarginal groove. Pleopod 2 appendix masculina sinuate, tapering to narrow bluntly rounded apex, 6.8 times as long as maximum width. Uropod nodular, with abundant setae; exopod 4.2 times as long as proximal width, about half as long as endopod, apex deeply bifid with lateral process prominent; endopod 3.5 times as long as wide, apex with prominent terminal spike.

Female. No females examined.

Colour. Pale yellow ground colour, chromatophores not apparent in preserved specimens.

Size. Males 3.2–3.4 mm, females 2.3–2.8 mm.

Remarks. This is currently the only species of the genus known from the Western Indian Ocean, and cannot be confused with any other sphaeromatids in the region (but see undescribed species). The only similar species is *Oxinasphaera tripartita*, a species known from Papua New Guinea and the Philippines, and *O. kensleyi* can be separated from that species by the far more prominent pereonal spikes and the sinuate penes and appendix masculina. Other differences are given in the 'Remarks' for *Oxinasphaera tripartita*.

The material examined here is that of Kensley (1984) which was incorrectly attributed to Richardson's species.

Distribution. Indian Ocean, off Durban [c. 30°S](Barnard 1920) and East London, South Africa; from c. 65 to 90 m.

Hosts. Barnard (1920) reported on the specimens that he examined: "in each case from siliceous sponges."

Etymology. The name is in recognition of Dr Brian Kensley's contributions to knowledge of the isopods and Crustacea of South Africa.

Oxinasphaera australis Baker, comb. nov.

Figures 50, 51

Cymodoce multidens var. *australis* Baker, 1929: 52, pl. 1 figs 4–6 [Non *Oxinasphaera multidens* (Richardson, 1910)].

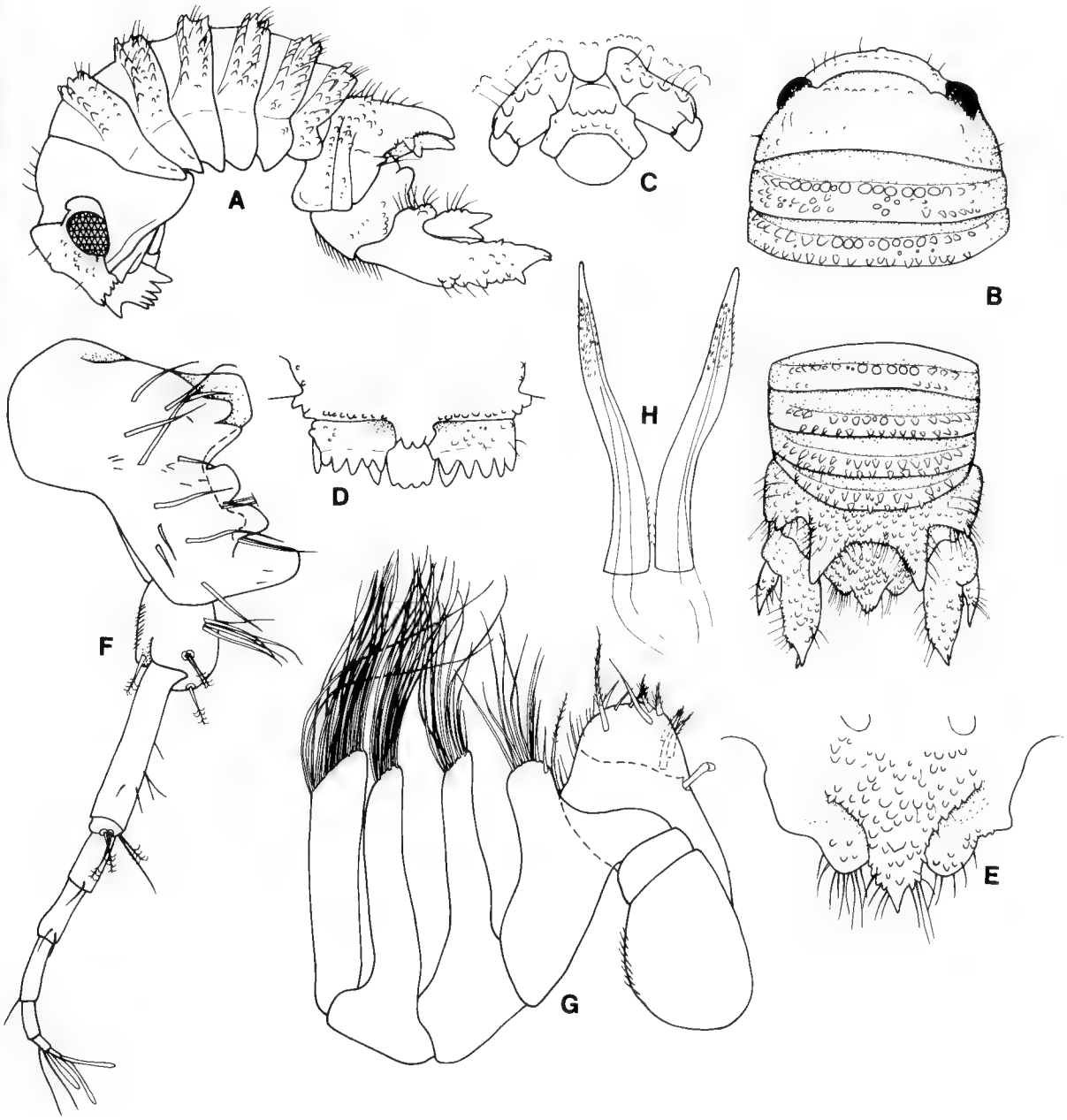


Figure 48. *Oxinasphaera kensleyi* sp. nov. A–D, holotype, E, ♂ 4.2 mm, F-G, ♂ 4.0 mm (SAfM A19308). A, lateral view; B, dorsal view (in two parts); C, frons; D, antennules, anterior view; E, pleotelson apex; F, antennule; G, maxilliped; H, penes. Scale 1.0 mm.

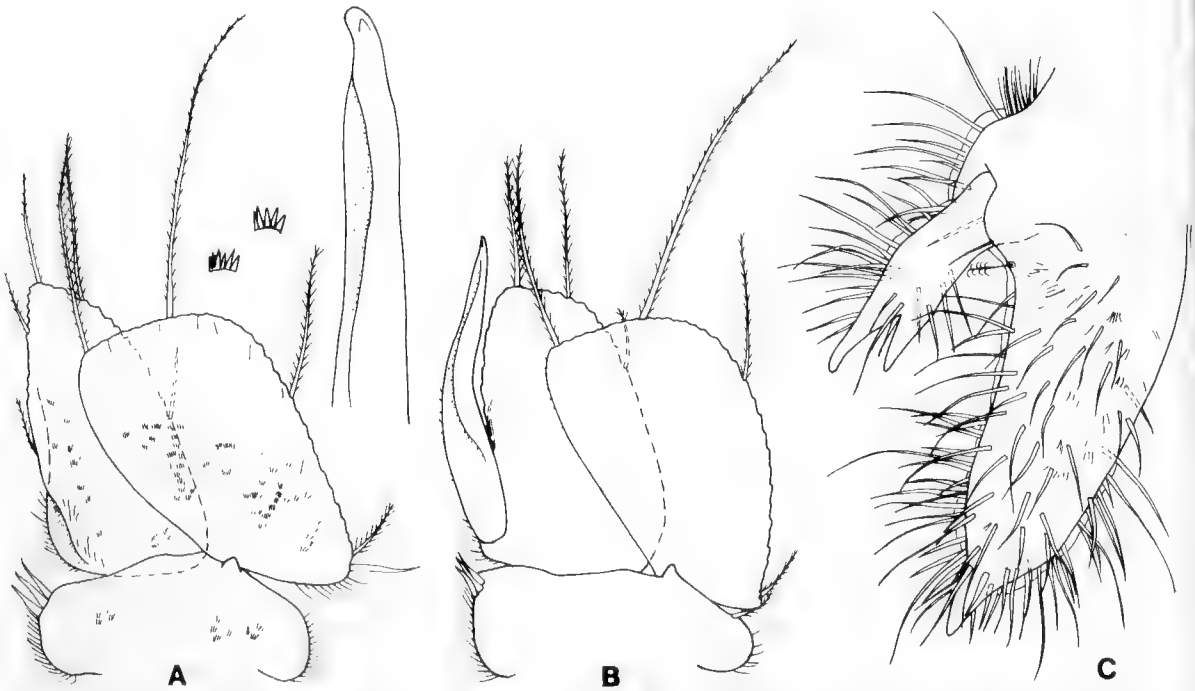


Figure 49. *Oxinasphaera kensleyi* sp. nov. ♂ 4.0 mm (SAfM A19308). A, pleopod 1; B, pleopod 2; C, uropod.

Material examined. Syntypes. 6♂ (5.7–6.6 mm, mean = 6.1 mm), 15 ♀ (ovig 8.4 [in 2 pieces], 10.2, non-ovig 7.5–9.3 mm, mean = 8.4 mm), Cottesloe, Perth, WA, no other data, L.G. Glauert (WAM 10385, 10484).

Description of male. Body about 2.2 times as long as wide. Cephalon anterior margin with 8–9 nodules, anterior median and 2 submedian nodules being prominent and elongate giving a tricornate appearance; with very weak obscure simple rostral spike. Pereonite 1 unornamented. Pereonites 2 -7 granular, each with 2 transverse rows of small low spikes, pereonite 1 with distinct anteromedial tubercle; coxae 5 and 6 posterior margins convex, with distinct posterior join to ventral margin, those of pereonite 7 entirely rounded posteriorly. Pleon without posterior boss, with 2 submedian clusters of tubercles; lateral flange with row of 3–5 spikes. Pleotelson dorsal surfaces granular; without prominent spikes; posterior margin somewhat flattened and produced, with 2 submedian triangular excisions.

Antennule peduncle article 1 with 8–9 irregular anterior spikes and 2 posteromedial spikes.

Epistome with 3 small distinct spikes, surface with numerous small granular tubercles.

Pereopod 1 propodus about 2.6 times as long as wide, posterior margin with distinct scale spikes and 6 large biserrate spines, row of 5 smaller biserrate spines on medial margin; dactylus about 0.4 length of propodus, unguis about 50% length of entire dactylus.

Penial processes examined *in situ*, generally similar to *O. bisubula* and *O. copiapoa.*

Pleopod 2 appendix masculina about as long as endopod, 6.4 times as long as maximum width, extending beyond endopod by 0.2 of its length, distally acuminate, recurved apex acute. Uropod not distinctly nodular, ventral margins of both rami with acute prominent downwardly projecting spikes; uropod exopod apex with two spikes, appearing bifid.

Female. Retains male pattern of ornamentation in reduced form; epistome spike more distinctly bifid. Pereonite 1 with low rounded submedian subanterior tubercles. Pleotelson posterior margin with shallow submedian excisions.

Colour. Pale yellow in the faded preserved specimens.

Size. Males 5.7–6.6 mm, ovigerous females 8.4–10.2 mm, non-ovigerous females 7.5–9.3 mm.

Remarks. There is no new material available for *O. australis.* The male syntypic specimens appear to have dried out at some time, and are in a fragile and brittle condition, with the pleopods

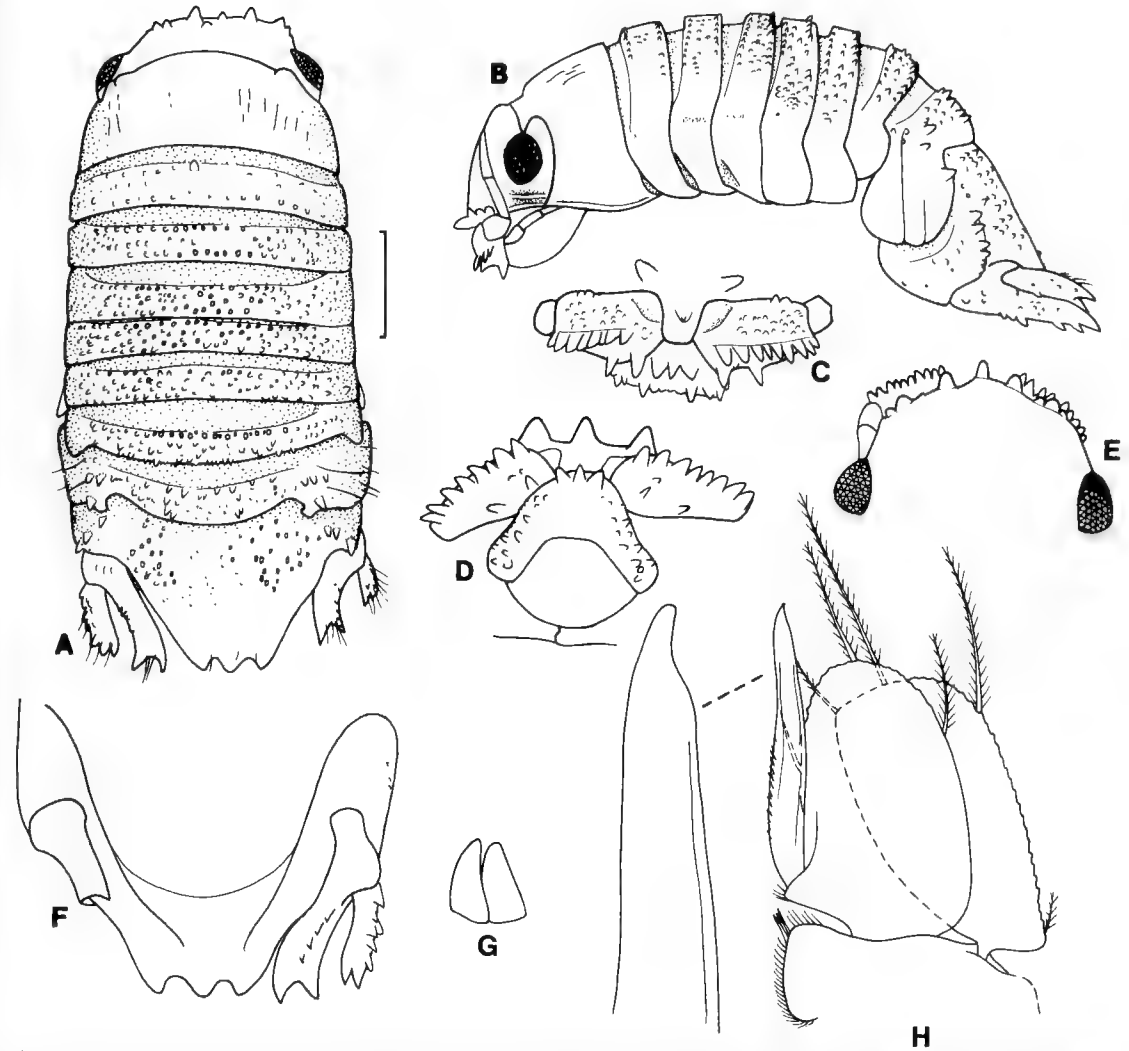


Figure 50. *Oxinasphaera australis* (Baker). A–E syntype ♂ 6.3 mm (WAM 10385/10484), remainder as indicated. A, dorsal view; B, lateral view; C, antennules, anterior view, in situ; D, frons; E, cephalon, dorsal view; F, pleon, ventral view; G, penes, in situ, ♂ 6.3 mm; H, pleopod 2, drawn from Baker's slide. Scale 1.0 mm.

and pereopods immovable. In none of the males were the penes clearly visible, and all specimens were too fragile to dissect. *Oxinasphaera australis* belongs to a group of species characterised by having the posterior margin of the pleotelson somewhat produced and flattened, and distinctly trilobate. The somatic morphology allows males and females of the species to easily distinguished from others of the genus. In particular the male of *O. australis* has prominent single rostral point flanked by two prominent tubercles on either side of the anterior margin of the cephalon, giving it a tricornate appearance; additionally there is a prominent median tubercle on the anterior of pereonite 2; the epistome anterior process is trilobate; antennule peduncle article 1 has 8–10 teeth on the anterior margin and 2 teeth on the posteromedial margin. All syntypic males showed this character, non-ovigerous females have smaller and more numerous (13) teeth on the antennule peduncle article 1 anterior margin and 3 on the posteromedial margin.

This species (and the other related species) also differ from the remainder of the genus in the females being manifestly larger than the males.

Distribution. Known only from the type locality, Cottesloe, Perth, WA.

Hosts. Not known

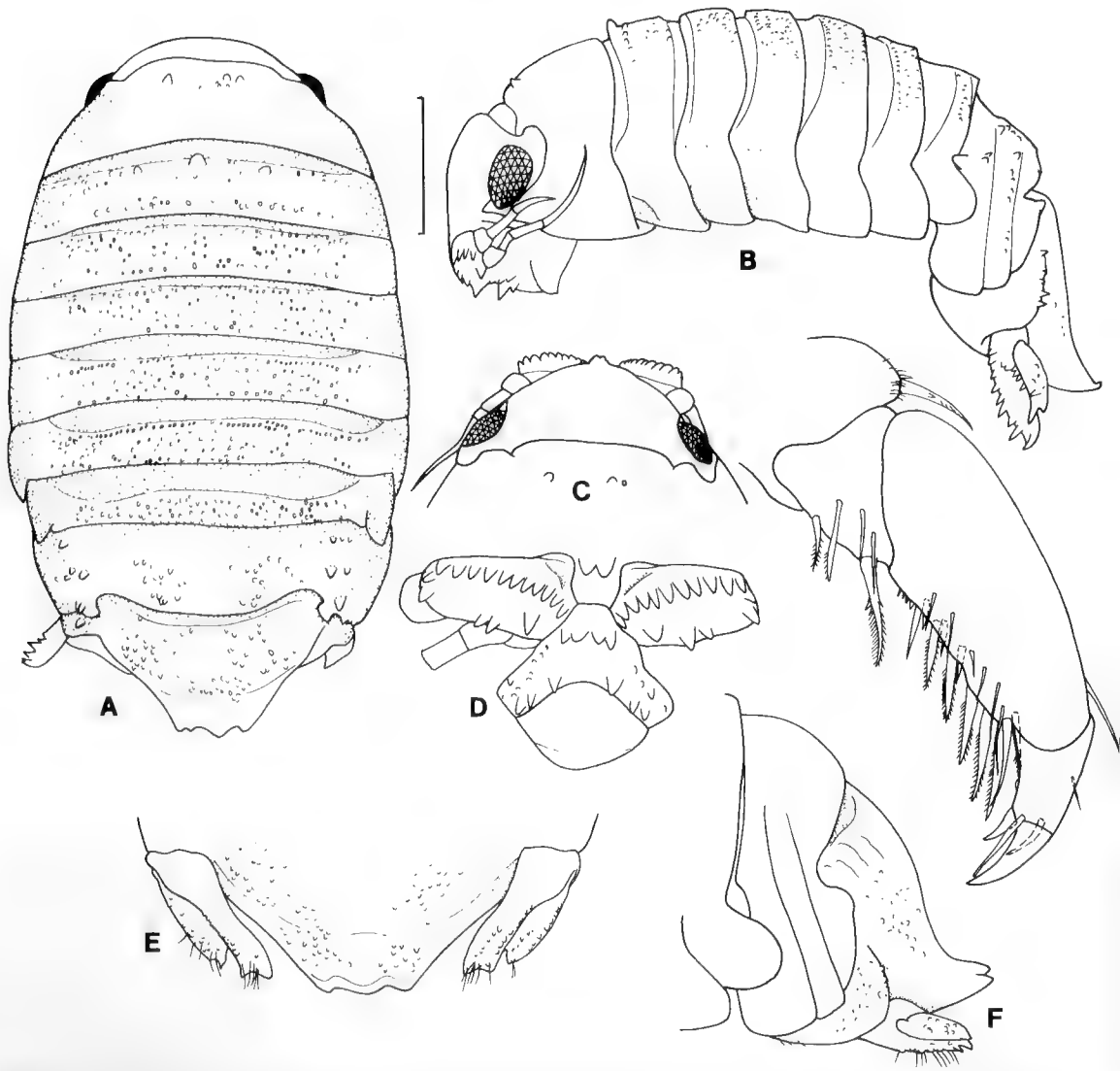


Figure 51. *Oxinasphaera australis* (Baker). A, E, F syntype, ovigerous ♀ 10.2 mm; B-D syntype, non-ovigerous ♀ 9.0 mm. A, dorsal view; B, lateral view; C, cephalon, dorsal view; D, frons; E, pleotelson posterior margin; F, pleon and pleotelson, lateral view; G, pereopod 1, non-ovigerous ♀ drawn from Baker's slide. Scale 1.0 mm.

Oxinasphaera matucana sp. nov.

Figures 52, 53

Material examined. Holotype, ♂ (5.6 mm), Pearson Is., Investigator Group, SA, 9 Jan 1969, 50 m, coarse gravel, S.A. Shepherd (SAM C5604).

Paratypes. ♂ (4.6 mm), NE side of Topgallant Is., Investigator Group, SA, 33°43.0′S, 134°36.6′E, 21 Apr 1965, 12 m, algae, bryozoa, sponges, S.A. Shepherd and G.C.B. Poore (NMV J40487). ♂ (5.0 mm), manca (2.8 mm), Bastion Point, Mallacoota, Vic., 37°34.3′S, 149°46.2′E, 6 Apr 1989, reef 300 m offshore, 5 m, sponges, G.C.B. Poore and R. Wilson (NMV J40483).

Description of male. Body about 2.2 times as long as greatest width; lateral margins subparallel. Cephalon dorsal surface finely pitted; anterior margin without tubercles; rostrum with bifurcate spike. Pereonite 1 with 2 distinct submedian rounded spikes posterior to anterior margin. Pereonites 2–7 each with 2 transverse rows of spikes, anterior row on pereonite 2 prominent with medial 5 being distinctly larger

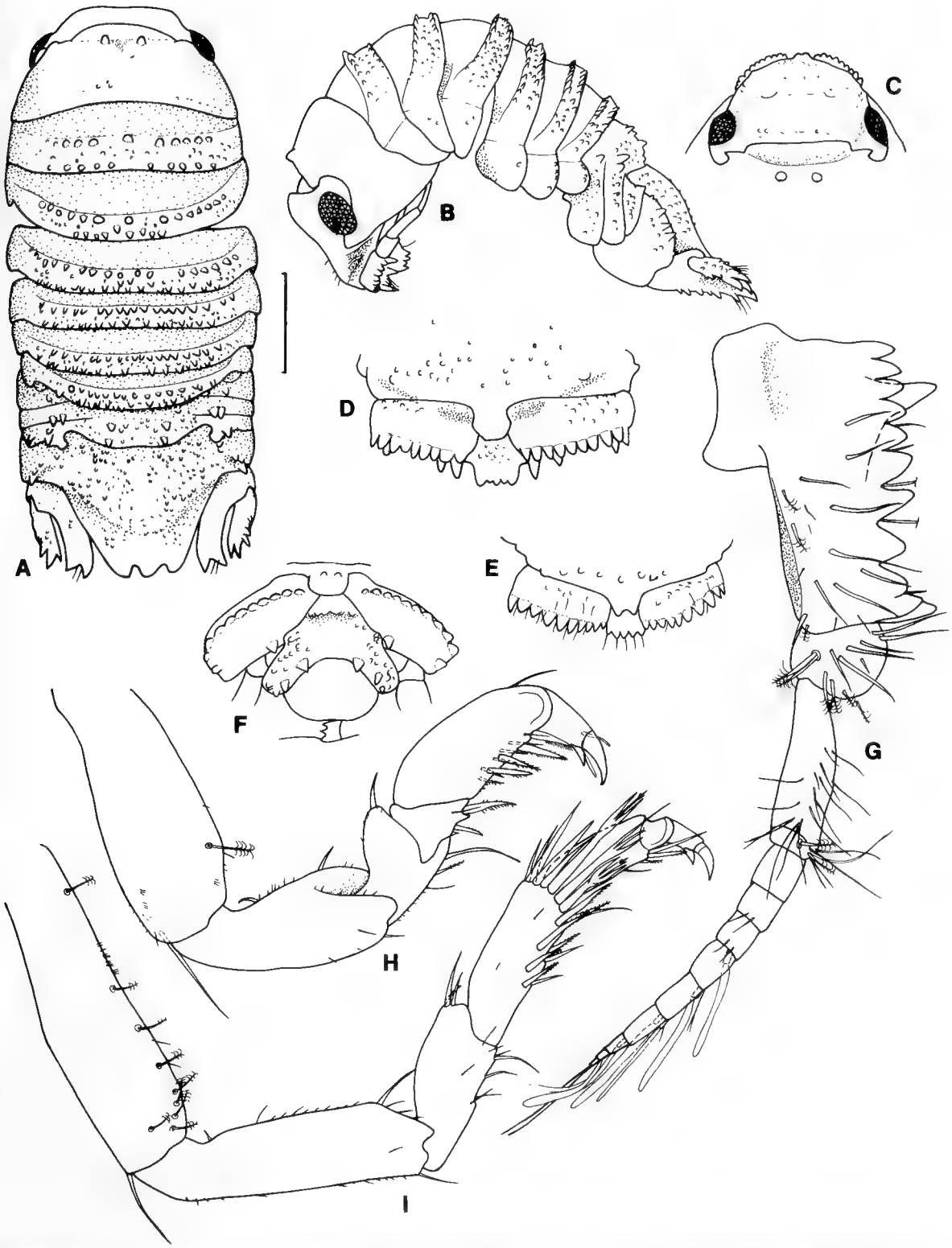


Figure 52. *Oxinasphaera matucana* sp. nov. A–D, F holotype, remainder ♂ 4.6 mm (NMV J40487). A, dorsal view; B, lateral view; C, cephalon, dorsal view; D, antennules, anterior view; E, antennules, anterior view; F, frons; G, antennule; H, pereopod 1; I, pereopod 7. Scale 1.0 mm.

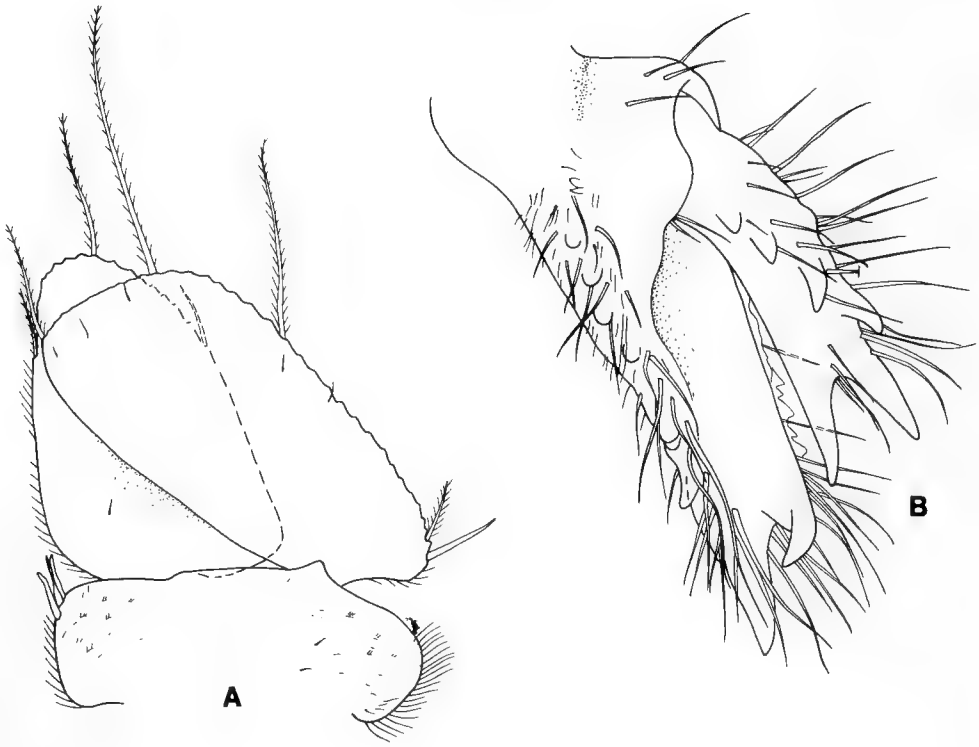


Figure 53. *Oxinasphaera matucana* sp. nov. ♂ 4.6 mm (NMV J40487). A, pleopod 1; B, uropod.

than all other pereonal spikes; pereonite 3 with anterior row larger than posterior but not as prominent as that of pereonite 2; pereonites 4–7 rows of about equal prominence; coxae 5–7 with posterior margins rounded. Pleon without posterior boss, with 2 longitudinally oriented submedian tubercles, pleonite 3 with 2 sublateral tubercles. Pleotelson without spikes or prominent tubercles; posterolateral flange with 3 marginal acute tubercles; posterior margin flattened, somewhat produced, with two submedian triangular excisions.

Antennule peduncle article 1 with 10 anterior spikes; with 1 long posteroproximal and 1 posterodistal spike; dorsal surface of peduncular articles 1 and 2 provided with roughened setae; flagellum with 9 articles.

Epistome without distinct spikes, with 4–5 teeth set on transverse ridge; lateral lobes each with 2 distinct spikes.

Pereopod 1 basis about 2.5 times as long as wide, anterior margin with 1 sensory seta; ischium 0.7 times as long as basis, 2.1 times as long as wide, anterior margin with 1 short proximal spine and 1 distal longer feebly biserrate spine; merus about one third as long as ischium, 0.7 times as long as wide, anterolateral angle with 1 gently curving weakly pectinate spine, posterior margin with 1 spine and single long simple seta; carpus about as long as merus, about as long as wide, posterior margin with 2 biserrate spines; propodus about equal in length (0.92) to ischium, widest proximally, about 2.4 times as long as wide, posterior margin with distinct scale spikes and 4 large biserrate spines, row of 5 smaller biserrate spines on medial margin; dactylus 0.5 length of propodus, unguis about 53% length of entire dactylus. Pereopod 7 basis 3.9 times as long as wide, anterior margin with 7 sensory setae; ischium slightly shorter (0.8) than

basis, 3.6 times as long as wide; merus about half as long as ischium, 1.8 times as long as wide, posterior margin with 3 simple spines, anterodistal angle with 1 large and 2 small spine; carpus 1.3 times as long as merus, 2.6 times as long as wide, posterior margin with 5 biserrate and 3 simple spines, distal margin with 3 large trifid spines, longest equal in length to propodus and 5 spines at anterodistal angle; propodus about 0.9 times as long as carpus and 0.5 time as long as ischium, about 3.0 times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 2 sensory setae.

Pleopods conforming to the genus; appendix masculina not observed. Uropod dorsally nodular, covered with roughened setae; exopod about 4 times as long as proximal width, about half as long as endopod, apex deeply bifid with processes about equally prominent, ventral margin with 3–4 prominent acute serrations; endopod about 3 times as long as wide, apex prominently bifid, ventral margin with 4–5 prominent acute serrations.

Female. Unknown.

Colour. Pale tan in alcohol.

Size. Males 4.6–5.6 mm, females 3.5–4.5 mm.

Remarks. Of the males examined here only the holotype had partly developed penial processes and a developing appendix masculina, not detached from the endopod of pleopod 2, and therefore all three specimens are regarded as immature. However, all specimens had clearly developed dorsal sculpting, and the pleotelson and uropods are of the adult male form. The ornamentation of the antennule, pereonite 1 and 2, and pleotelson and uropods clearly separates *Oxinasphaera matucana* from other species of the *O. australis* group and the remaining species of the genus, and a new species is therefore established.

Distribution. Mallacoota, Victoria, westwards to the Investigator Group, South Australia, at depths between 5 and 50 m.

Hosts. One specimen recorded from an unidentified sponge.

Oxinasphaera poorei sp. nov.

Figures 54, 55

Material examined. Holotype. ♂ (2.9 mm), Bastion Point, Mallacoota, Vic., 37°34.3'S, 149°46.2'E, 6 Apr 1989, reef 300 m offshore, 5 m, sponges, G.C.B. Poore and R.S. Wilson (NMV J40488).

Paratypes. 2♂ (2.7, 3.3 mm), same data as holotype (NMV J40498).

Description of male. Cephalon irregularly pitted; with prominent flattened indistinctly bifurcate rostral point; anterior margin without spikes, with single prominent anteriorly projecting flange. Pereonite 1 without tubercles or ornamentation. Pereonites 2–6 each with anterior transverse row of distinctly flattened rounded spikes, pereonite 7 spikes not markedly flattened; posterior rows of pereonal spikes all weakly developed; coxae 5–7 with posterior margins nearly straight, ventral margin subtruncate, that of coxa 6 weakly concave. Pleon without posterior boss, although posterior margin weakly produced; pleonites 3 and 4 each with large sublateral tubercle, otherwise without prominent spikes. Pleotelson generally nodular, with 4 prominent rounded tubercles across anterior, posterior margin with two prominent submedian indentations either side of median lobe .

Antennule peduncle article 1 with 3 wide rounded anterior spikes, and large proximal length set just posterior to front row; without posterior spikes; flagellum with 6 articles.

Epistome with 2 basally united, distally acute, flat spikes.

Pereopod 1 basis about 2.6 times as long as wide, anterior margin with 2 sensory setae, distally with scale spikes; ischium about 0.6 times as long as basis, about 2.3 times as long as wide, anterior margin with 1 short proximal and 1 distal longer and biserrate spines; merus 0.5 times as long as ischium, about as long as wide, anterolateral angle with 1 gently curving pectinate spine, posterior margin 1 biserrate spine and 1 long seta; carpus as long as merus, about 1.5 times as long as wide, posterior margin with 2 biserrate spines; propodus about (1.1) as long as ischium, widest proximally, about 2.5 times as long as wide, posterior margin with 2 large biserrate spines; dactylus about 0.6 length of propodus, unguis about 52% length of entire dactylus. Pereopod 2 similar to others, merus distal margin with 4 biserrate spines. Pereopod 7 basis 3.6 times as long as wide, anterior margin with scale spikes, with prominent seta at anterodistal angle; ischium 0.68 as long as basis, 2.8 times as long as wide; merus about half as long as ischium, 1.6 times as long as wide, posterior margin with 3 feebly biserrate spines, 2 biserrate spines at anterodistal angle; carpus slightly longer (1.1) than merus, 2 2 times as long as wide, posterior margin with 4 large biserrate

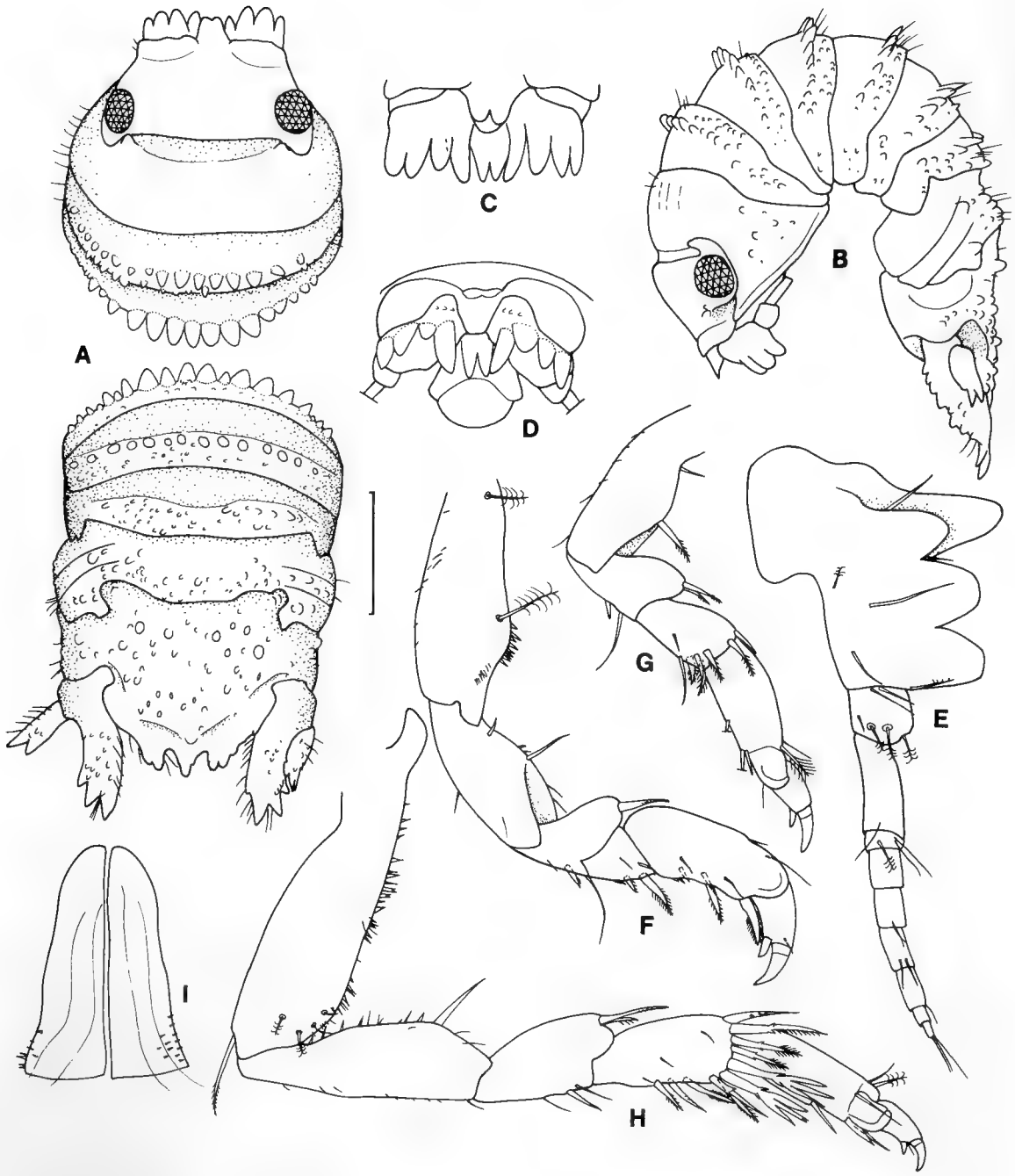


Figure 54. *Oxinasphaera poorei* sp. nov. A–D, holotype, remainder ♂ 2.7 mm (NMV J40487). A, dorsal view (two parts); B. lateral view; C, antennules, anterior view, in situ; D, frons; E, antennule; F, pereopod 1; G, pereopod 2; H, pereopod 7; I, penes. Scale 0.5 mm.

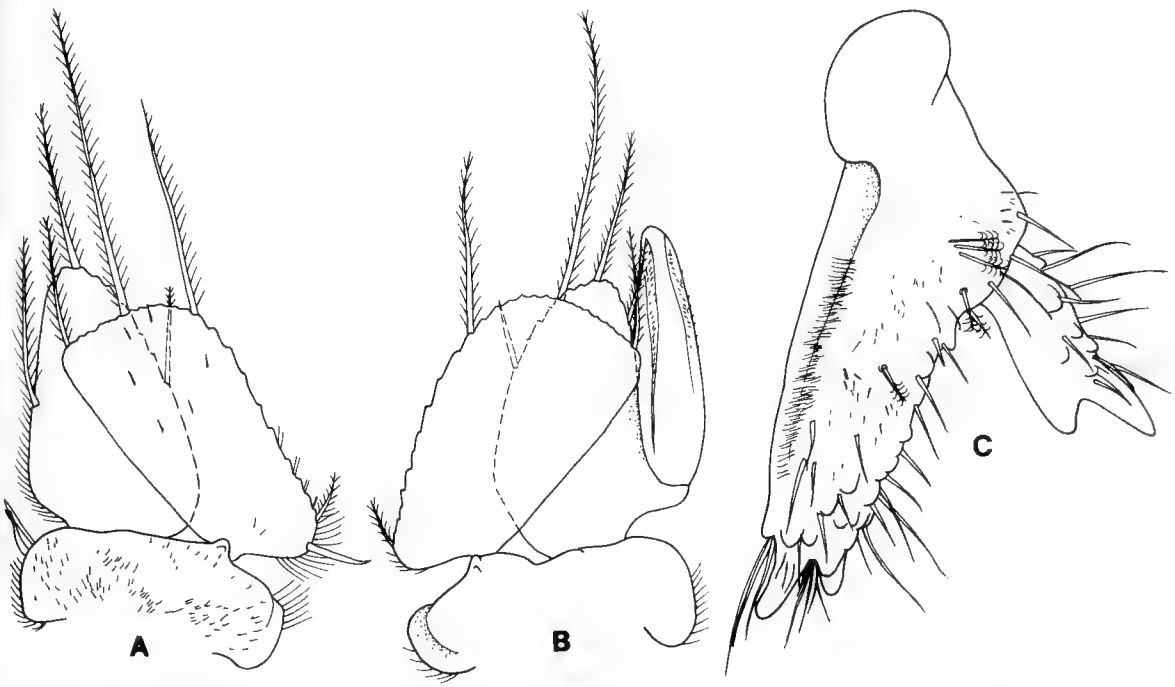


Figure 55. *Oxinasphaera poorei* sp. nov. ♂ 2.7 mm (NMV J40487). A, pleopod 1; B, pleopod 2; C, uropod.

spines, distal margin with 2 trifid and 3 biserrate spines, anterodistal angle with single weakly biserrate spine; propodus about 1.2 times as long as carpus and about 2.6 times as long as wide, posterior margin with 3 biserrate spines, anterodistal angle with 2 simple and 1 sensory setae.

Penial processes each about 2.8 times as long as basal width, medial margin straight, lateral curving to subacute apex; proximolateral margin with scale spikes.

Pleopod 1 endopod medial PMS inserted dorsally. Pleopod 2 appendix masculina stout, 4.0 times as long as maximum width, about as long as endopod, extending beyond endopod by 0.2 of its length, apex bluntly truncated. Uropod dorsally nodular; exopod about 3.3 times as long as proximal width, about 0.4 times as long as endopod, apex deeply bifid with lateral process prominent; endopod about 3.5 times as long as wide, apex with 2 prominent spikes, additional rounded nodules along ventral margin.

Female. Unknown.

Colour. Pale yellow in alcohol.

Size. Males 2.7–3.3 mm.

Remarks. This species is unique within the genus in possessing flattened pereonal spikes, and in having the anterior margin of the cephalon with a distinct hardened ridge. The antennule, with only 4 flattened spikes, the lack of pleonal boss and simple posterior notches to the posterior margin of the pleotelson all further serve to identify the species.

Distribution. Known only from the type locality.

Hosts. Unidentified sponge.

Etymology. Named in recognition of Gary C.B. Poore's contribution to the knowledge of Australian isopod and crustacean fauna.

Oxinasphaera islaya sp. nov.

Figures 56–58

Material examined. Holotype. ♂ (2.8 mm), 2 km S of Cape Peron, WA, 32°16′S, 115°41′E, 26 Dec 1983, 6 m, from sponges, cave in reef, J.K. Lowry (AM P44197).

Paratypes. 16♂ (2.0–2.5 mm, mean= 2.3 mm), 11 mancas (2.1, 2.0, 1.9, 1.8, 1.7 mm and 6 1.2–1.8 mm), same data as holotype (AM P41118, slides P44215, P44216; ZMUC CRU1386).

Additional material. 5♂ (2.2 imm, 2.3, 3.0, 3.0, 3.5 mm), "The Hotspot" reef, 5 nm W of N end of Flinders Is., SA, 33°40.5′S, 134°22.0′E, 19 Apr 1985, 12 m, assorted algae, S. Shepherd (NMV J40484).

Description of male. Body about 2.3 times as long as greatest width; lateral margins subparallel; dorsal surfaces polished, anteriorly with

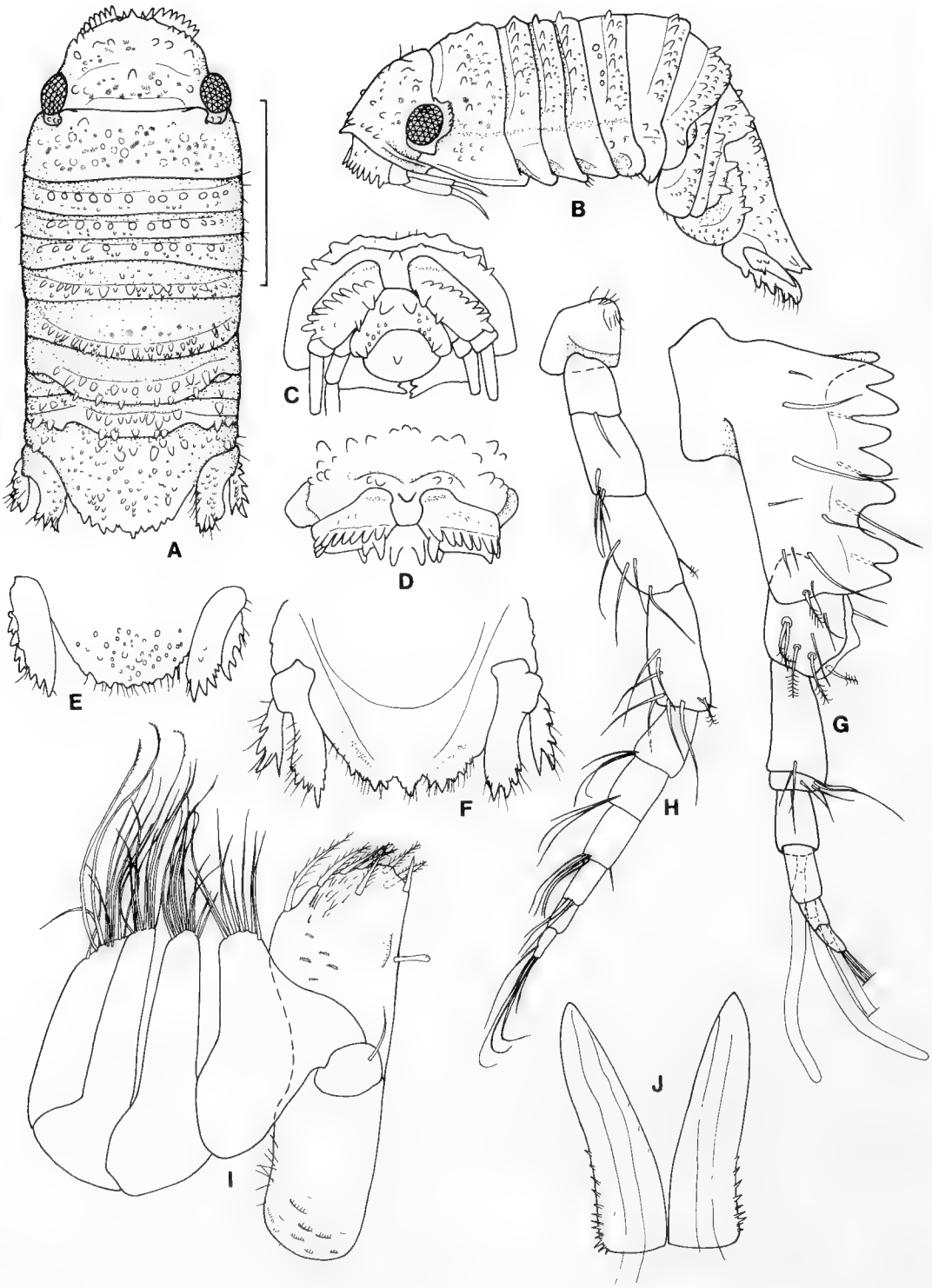


Figure 56. *Oxinasphaera islaya* sp. nov. A–D, F holotype, remainder ♂ 2.1 mm (AM P41118). A, dorsal view; B, lateral view; C, frons; D, antennules, anterior view, in situ; E, posterior margin of pleon; F, pleon, ventral view; G, antennule; H, antenna; I, maxilliped; J, penes. Scale 1.0 mm.

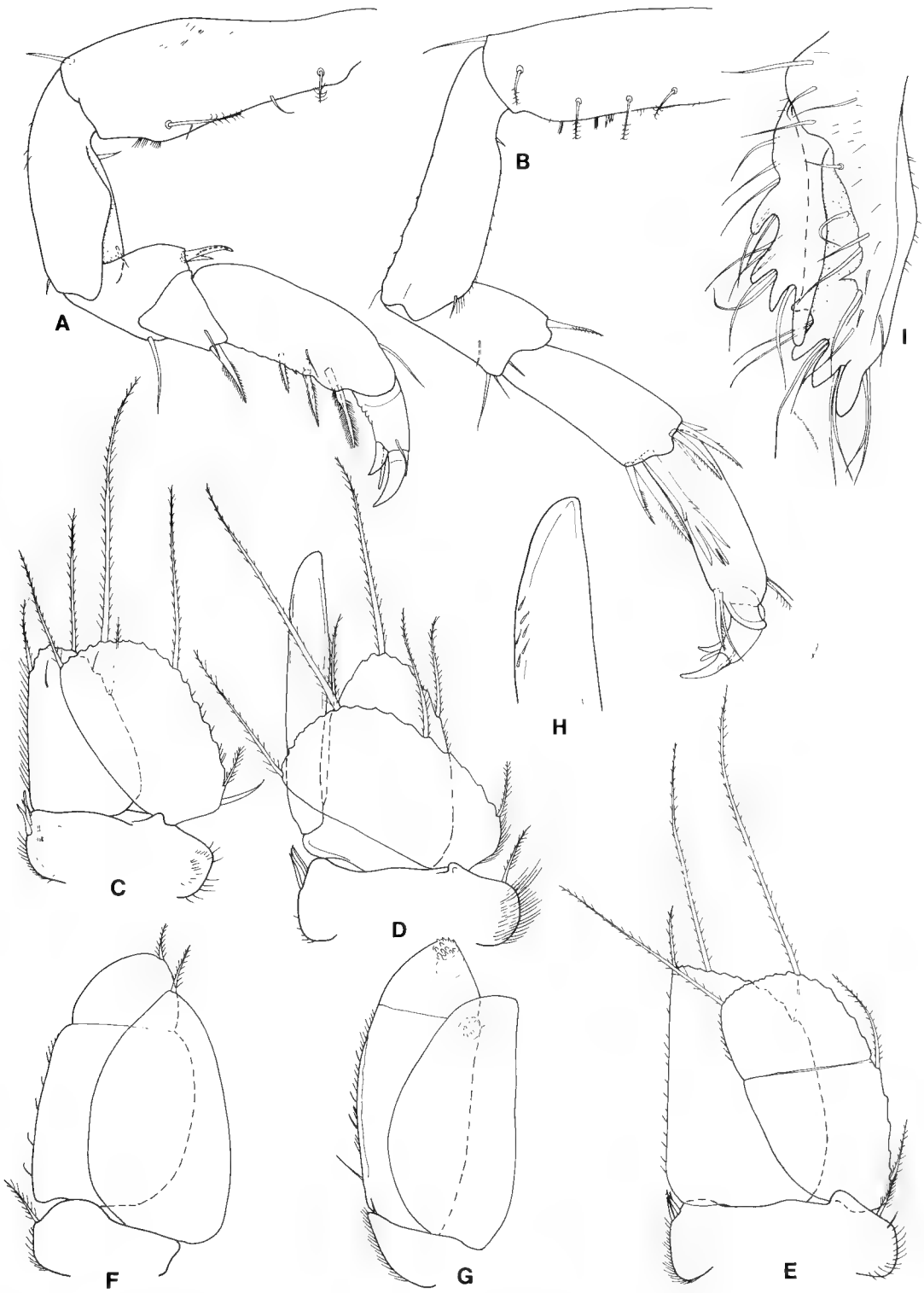


Figure 57. *Oxinasphaera islaya* sp. nov. H, F, ♂ 2.0 mm, remainder ♂ 2.1 mm (AM P41118). A, pereopod 1; B, pereopod 7; C-G, pleopods 1–5 respectively; H, appendix masculina apex; I, uropod.

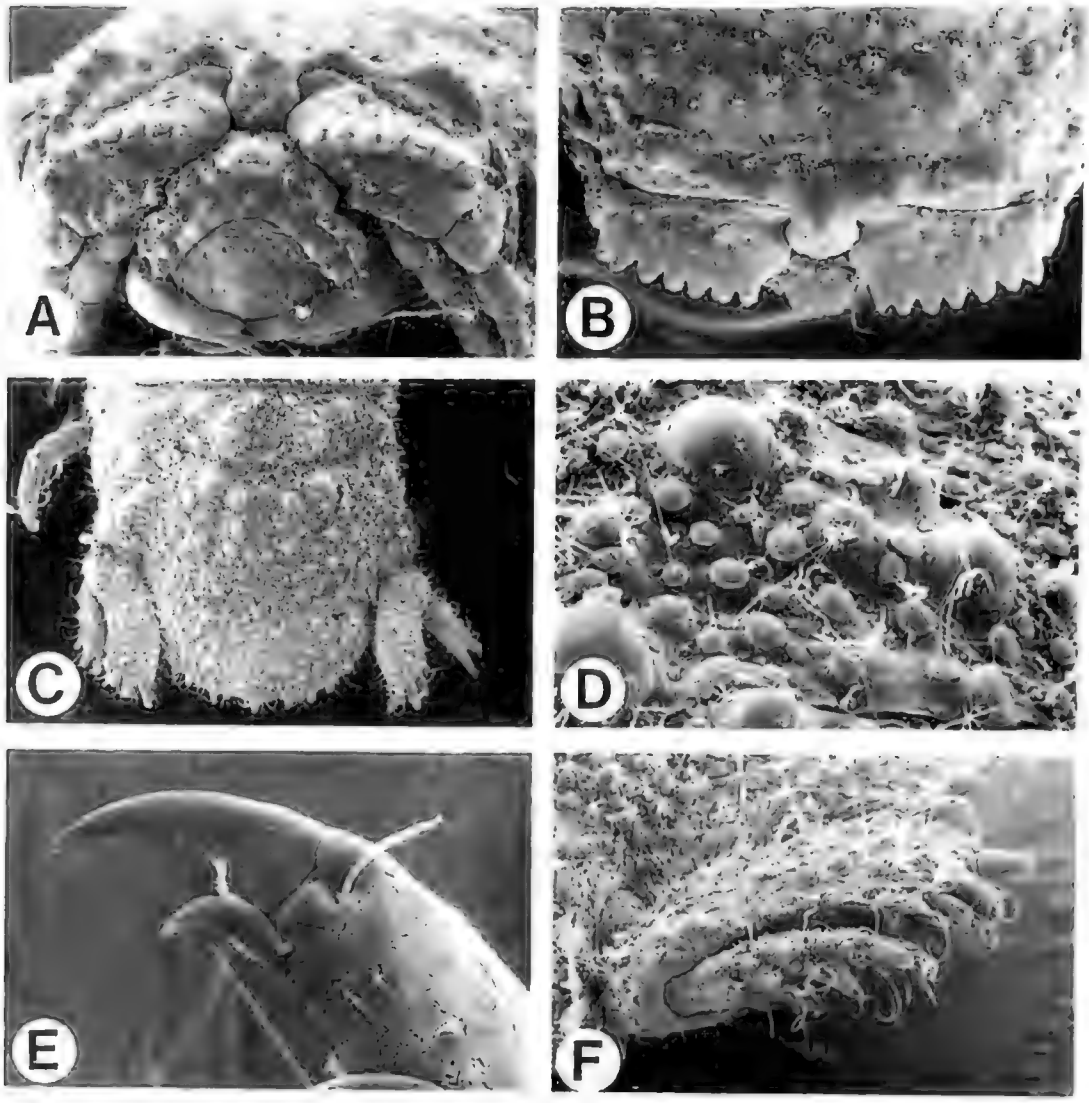


Figure 58. *Oxinasphaera islava* sp. nov. SEMs. ♂ 2.7 mm (AM P41118). A, cephalon, anterior view (×100); B, cephalon anterior margin (×150); C, pleon and pleotelson (×75); D, detail, pleotelson tubercles (×550); E, pereopod dactylus (×1100); F, uropods (×190).

large pits, otherwise sparsely setose. Cephalon anterior margin with 3–4 small lateral tubercles; rostrum spike simple. Pereonite 1 with smooth low nodules, large shallow pits. Pereonites 2–4 with only anterior spike row distinct, pereonites 5–7 each with 2 transverse rows of spikes, anterior row large, posterior row indistinct; all spikes rounded; coxae 5 with posterior margins evenly rounded, coxae 6 ventrally subacute, coxae 7 rounded. Pleon with weak posterior boss, posterolateral angles of boss each with 2 rounded spikes; lateral margin of pleonite 4 with 2 prominent rounded tubercles. Pleotelson with 2 rounded spikes opposing those of pleon, otherwise surface irregularly nodulose; posterolateral flange with 1 submarginal and 3–4 rounded tubercles; posterior margin appearing serrate, with 2 weak submedian indentations either side of median lobe .

Antennule peduncle article 1 with 7 anterior spikes; with 1 long proximo-posterior spike and 1 short posterior spike; dorsal surface of peduncular articles 1 and 2 provided with few setae; flagellum with 4 articles. Antenna peduncle

articles 4 and 5 with few long setae; flagellum of about 6 articles.

Epistome with 2 prominent widely separated conical spikes, lateral lobes each with 1 small tubercle.

Pereopod 1 basis 2.9 times as long as wide, anterior margin with 2 sensory setae, few scale spikes, anterodistal angle with prominent single seta; ischium 0.7 times as long as basis, 2.5 times as long as wide, anterior margin with 1 short proximal spine; merus about half as long as ischium, about as long as wide, anterodistal angle with 2 stout curving pectinate spines, posterior margin with single long simple seta; carpus about as long as merus, 1.4 times as long as wide, posterior margin with 1 biserrate spine and short simple seta; propodus about equal in length to ischium, widest proximally, about 2.6 times as long as wide, posterior margin irregularly notched and 3 large biserrate spines, 2 smaller biserrate spines on medial margin; dactylus about half length of propodus, unguis about 51% length of entire dactylus. Pereopods 2 and 3 similar to 1, differing principally in having the carpus more elongate and propodus more slender, and having additional biserrate seta on distal margin of carpus. Pereopod 7 ischium 3.1 times as long as wide; merus 0.5 times as long as ischium, 1.6 times as long as wide, anterodistal angle with 1 large spine, posterodistal angle with 2 simple setae; carpus 1.2 times as long as merus, 2.5 times as long as wide, posterodistal angle with 2 biserrate and 1 large trifid spines, anterodistal angle with 2 biserrate and 2 simple spines; propodus about 1.2 times as long as carpus and 0.8 time as long as ischium, about 3.9 times as long as wide, posterodistal angle with 1 biserrate spine, anterodistal angle with 1 sensory and 1 simple setae.

Penial processes each about 3.7 times as long as basal width, tapering slightly to a subacute apex; proximolateral margin with scale spikes.

Pleopod 2 endopod appendix masculina straight, 5.8 times as long as maximum width, apex rounded and narrowed, longer (1.3) than endopod, extending beyond endopod by 0.35 of its length. Pleopod 4 exopod and exopod with single seta at distomedial angle, endopod without thickened fleshy ridges. Pleopod 5 exopod with 1 apical lateral scale lobe 1 medial apical scale lobe, endopod without thickened fleshy ridges. Uropod dorsally finely nodular; exopod about 3.8 times as long as proximal width, about two-thirds as long as endopod, apex not distinctly bifid, with lateral process being distal part of series of prominent ventral serrations; endopod about 3.6 times as long as wide, apex with row of 4 terminal prominent spikes.

Female. Unknown.

Colour. Pale brown to dark brown.

Size. Males 2.0–3.5 mm, mancas 1.2–2.1 mm.

Variation. The posterior margin of the pleotelson in some specimens shows the typical trilobate or bi-excavate appearance that is common to most species of the genus. In some specimens this character was very unclearly expressed.

Remarks. This species is the smallest of the genus, the nearly entire pleotelson posterior margin enabling easy recognition. The anterior dorsal surfaces are pitted but, with the polished cuticle, this does not give a roughened appearance. Other distinguishing characters are the relatively long appendix masculina, the lack of ridges on pleopods 4 and 5 and the distinctly saw edged appearance of the uropodal exopod.

Distribution. Cape Peron, southern Western Australia and Flinders Is., South Australia, 6 to 12 metres depth.

Hosts. Type series taken from an unidentified sponge.

Undescribed Species

Oxinasphaera sp. 1. (Fig. 59)

Material examined. 3 ♂/♀ (4.4, 4.5, 4.6 mm), 4 ♀ (ovig 6.0, non-ovig 4.6, 4.7, 5.0 mm), 2 km S of Cape Peron, WA, 32°16′S, 115°41′E, 6 m, from sponges, gorgonaceans from cave in reef, J.K. Lowry (AM P44198).

Remarks. Among the specimens from Western Australia is a species of *Oxinapshaera* that could not be assigned to any of the species in the present work. It is most similar to *O. australis*, from which it differs in lacking a prominent median tubercle on percomite 2, having the posterior margin of the pleotelson entire in intersex and female specimens, and in the deeply serrated uropods. It is included here in order to draw attention to this species and avoid its confusion with *O. australis*, also known only from Western Australia.

There are no male specimens in this series. Those marked as "♂/♀" lack penes, appendix masculina and show a degree of ornamentation that is not normally found in females. Those identified as females are unornamented and, as in *O. australis*, are larger than the males. The cephalic, antennular and epistome ornamentation of the intersex specimens and the ornamentation of the uropods and posterior margin

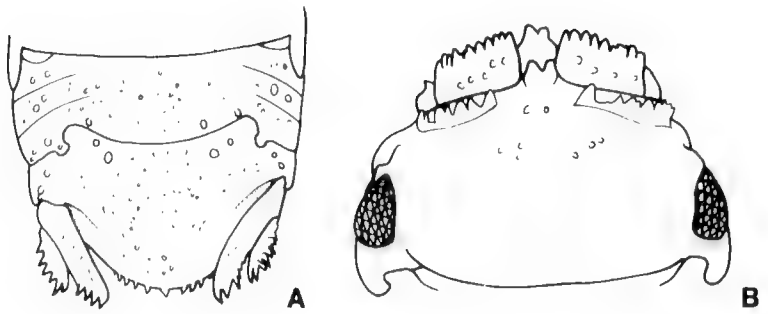


Figure 59. *Oxinasphaera* sp. 1 (AM P41118).

of the pleotelson precludes assignment to any of the species treated here. Specimens that are clearly recognizable as mature are needed before the species can be named and fully described.

Oxinasphaera sp. 2. 1♂, western Bass Strait, 39°16.7′S, 143°06.7′E. 95 m (NMV J40478). Senescent male, without clearly developed antennule spikes; differs from other species in having a transverse row of 4 spikes across the pleon.

Oxinasphaera sp. 3. 1♂, Burrewarra Point, NSW, 35°50′S, 150°14′S, 17 m (NMV J26234). Heavily granular pleon, one of the *O. bisubula* group.

Oxinasphaera sp. 4. 1♂, Spiky Bridge Coastal Reserve, Tasmania, 42°08′S, 148°08′E (NMV J40485). Antennule with 5 spikes, dorsal pereonal tubercles prominent and rounded, cephalon anterior margin with 2–3 flattened teeth; pleotelson similar to the *O. bisubula* group. Although distinctive, more males are needed to confirm that the cephalic spike development is typical.

Oxinasphaera spp. 5–7. Northern Indian Ocean, USNM. These sublittoral species, currently under study by Brian Kensley and Marilyn Schotte, all have prominent pleonal processes, and show a diverse pereonal spike, pleotelson, antennule, epistome and uropod morphology. They are noted here as these specimens clearly demonstrate the presence of the genus in the western and northern Indian Ocean (Fig. 2).

Acknowledgements

This contribution was funded by a grant from the Australian Biological Resources Study (ABRS 89/1844)

I thank all those who assisted when visiting their institutions and who lent the specimens used in this study: Dr Penny B. Berents (AM), Dr A.J. Bruce and Ms Karen Coombes (NTM), Mr Peter J.F. Davie and Mr. John Short (QM), Dr Gary C. B. Poore and Dr Robin S. Wilson (NMV), Mr Wolfgang Zeidler (SAM), Dr Brian Kensley and Marilyn Schotte (USNM, Smithsonian Institution), Ms Melissa Hewitt (WAM), and Ms Liz Hoensen (SAfM). I also thank Mr Jørgen Olesen (ZMUC) for his careful inking and assistance with running the PAUP programme, and Dr John N. A. Hooper (QM) for confirming and correcting the nomenclature of the sponge identifications.

References

Baker, W.H., 1908. Notes on some species of the isopod family Sphaeromidae, from the South Australian coast. *Transactions of the Royal Society of South Australia* 32: 138–162, pls 1–10.

Baker, W.H., 1910. Notes on some species of the isopod family Sphaeromidae from the South Australian coast. Part II. *Transactions of the Royal Society of South Australia* 34: 75–88, pls 21–24.

Baker, W.H., 1926. Species of the isopod family Sphaeromidae, from eastern, southern and western coasts of Australia. *Transactions of the Royal Society of South Australia* 50: 247–279, pls 38–53.

Baker, W.H., 1929. Australian species of the isopod family Sphaeromidae. *Transactions of the Royal Society of South Australia* 52: 49–61, pls 1–6.

Barnard, K.H., 1914. Contributions to the crustacean fauna of South Africa. No. 3. Additions to the Isopoda, with notes on some previously incompletely known species. *Annals of the South African Museum* 10: 325a–358a, 359–442.

Barnard, K.H., 1920. Contributions to the crustacean fauna of South Africa. No. 6. Further additions to the list of marine Isopoda. *Annals of the South African Museum* 17: 319–438.

Barnard, K.H., 1940. Contributions to the crustacean fauna of South Africa 12. Further additions to the Tanaidacea, Isopoda and Amphipoda, together with keys for the identification of hitherto recorded marine and freshwater species. *Annals of the South African Museum* 32: 381–543.

Boone, P.L., 1923. New marine tanaid and isopod Crustacea from California. *Proceedings of the Biological Society of Washington* 37: 147–156.

Bruce, N.L., 1980. The systematics of some Japanese marine isopods (Fam. Sphaeromatidae) of the genera *Dynoides* Barnard, 1914 and *Cymodocella* Pfeffer, 1887, with descriptions of two new species. *Crustaceana* 38: 199–211.

Bruce, N.L., 1993. Two new genera of marine isopod crustaceans (Flabellifera: Sphaeromatidae) from southern Australia, with a reappraisal of the Sphaeromatidae. *Invertebrate Taxonomy* 7: 151–71.

Bruce, N.L., 1994a. Redescription of three poorly known sphaeromatid genera (Crustacea: Isopoda) from south-eastern Australia. *Memoirs of the Museum of Victoria* 54: 149–170.

Bruce, N.L., 1994b. The Cassidininae Hansen, 1905 (Isopoda : Sphaeromatidae) of Australia. *Journal of Natural History* 28: 1077–1173.

Bruce, N.L., 1994c. Four new genera of marine isopod crustaceans (Sphaeromatidae) from eastern and southern Australia. *Memoirs of the Museum of Victoria* 54: 399–437.

Bruce, N.L., 1995. The taxonomy and phylogeny of tube-tailed sphaeromatid isopods (Crustacea) with descriptions of new species and a new genus from southern Australia. *Ophelia* 43: 127–180.

Brusca, R.C. and G.D.F. Wilson, 1991. A phylogenetic analysis of the Isopoda with some classificatory recommendations. *Memoirs of the Queensland Museum* 31: 143–204.

Dumay, D., 1972a. Révision systematique du genre *Cymodoce* (Isopoda Flabellifera). 1. — Introduction et description de deux espèces: *Cymodoce truncata* (Montagu) et *C. (truncata) pilosa* Milne-Edwards. *Tethys* 3 [1971]: 639–654.

Dumay, D., 1972b. Révision systematique du genre *Cymodoce* (Isopoda Flabellifera). II.- Description de *Cymodoce hanseni* nov. sp. des côtes Méditerranéennes. *Crustaceana* Supplement 3:198–206.

Dumay, D., 1972c. Révision systematique du genre *Cymodoce* (Isopoda Flabellifera). III.- Description de *C. spinosa* (Risso) et *C. emarginata* sensu Torelli. *Tethys* 4: 127–144.

Dumay, D., 1972d. Révision systematique du genre *Cymodoce* (Isopoda Flabellifera). IV.- Description de *C. tatersalli* Torelli, *C. rubropunctata* (Grube), *C. tuberculata* Costa. Clef systématique et conclusion générale. *Tethys* 4: 457–480.

Harrison, K. and Holdich, D.M., 1984. Hemibranchiate sphaeromatids (Crustacea: Isopoda) from Queensland, Australia, with a world-wide review of the genera discussed. *Zoological Journal of the Linnean Society* 81: 275–387.

Hurley, D.E. and Jansen, P., 1977. The marine fauna of New Zealand: Family Sphaeromatidae (Crustacea : Isopoda : Flabellifera). *Memoirs of the New Zealand Oceanographic Institute* 63: 1–95.

Kensley, B., 1978. *Guide to the marine isopods of Southern Africa.* Trustees of the South African Museum: Cape Town. 173 pp.

Kensley, B., 1984. The South African Museum's *Meiring Naude* cruises. Part 15. Marine Isopoda of the 1977, 1978, 1979 cruises. *Annals of the South African Museum* 93: 213–301.

Kussakin, O.G. and Malyutina, M.V., 1987. Marine Isopoda (Crustacea) from the shore of Zaliv Petra Velikogo. Pp 47–67 in: Gulbin, V.V. (ed.), *Issledovaniya litorali Dal'nevostochnogo morskogo zapovedvika i sopredel'nykh raionov.* DVO AN SSSR: Vladivostok.

Kussakin, O.G. and Malyutina, M.V., 1993. Sphaeromatidae (Crustcea: Isopoda: Flabellifera) from the South China Sea. *Invertebrate Taxonomy* 7: 1167–1203.

Leach, W.E., 1814. Crustaceology. In: *Brewster's Edinburgh Encyclopedia* 7: 383–437.

Miers, E.J., 1876. Descriptions of some new species of Crustacea, chiefly from New Zealand. *Annals and Magazine of Natural History* (series 4) 17: 218–229.

Nierstrasz, H.F., 19311. Die Isopoden der Siboga-Expedition. III. Isopoda Genuina. II. Flabellifera. *Siboga-Expeditie Monograph* 32c: 123–233, 2 pls.

Richardson, H., 1910. Marine isopods collected in the Philippines by the U.S. Fisheries Steamer Albatross in 1907–08. *Department of Commerce and Labor, Bureau of Fisheries Document* 736: 1–44.

Ràha, J. and Subàk, R., 1987. *Den Store Bog om Kaktus og andre Sukkulenter.* Danish Edition. Hernovs Forlag: Copenhagen. 352 pp.

Stebbing, T.R.R., 1873. A sphaeromatid from Australia, and Arcturidae from South Africa. *Annals and Magazine of Natural History* 7 (series 4): 95–98.

Stebbing, T.R.R., 1900. One some crustaceans from the Falkland Islands collected by Mr Rupert Valentin. *Proceedings of the Zoological Society of London* 1900: 517–568.

Whitelegge, T., 1902. Crustacea. Part III. Scientific Results of the trawling Expedition of H.M.C.S. "Thetis". Vol. 1. *Memoirs of the Australian Museum* 4: 247–283.

Wägele, J.-W., 1989. Evolution und phylogenetisches System der Isopoda. *Zoologica* 140: 1–262.

Appendix 1

Character Matrix. Character state and distribution of the 31 character used in the analysis (? = character not present; — = state unknown).

	0	0	1	1	2	2	3
Characters	12345	67890	12345	67890	12345	67890	1
Cymodoce	00000	00010	00010	00000	00000	01000	0
Sphaeroma	00000	00000	0000?	??000	00000	00000	0
bisubula	12000	11011	11010	00001	00000	00000	1
parodia	02000	11011	11010	00001	00100	00001	1
lobivia	12000	11011	01010	00001	00000	00000	1
frailea	12001	11011	01010	00001	00000	00001	1
denmoza	02000	11111	11010	00001	00000	00000	1
copiapoa	02001	11011	11010	00001	00000	00001	1
multidens	00000	00111	11010	00001	00100	01000	1
corypantha	00000	00111	11010	00001	00100	00100	1
obregonia	11000	11001	01010	00001	00000	01000	1
tual	11000	01111	11010	00001	00100	01111	1
aylostera	02010	11000	10010	11101	00000	00000	1
rebutia	00111	11000	00010	11101	00000	00000	1
tuberculosa	02000	10000	00020	?1010	00000	10001	1
epostoa	00000	11000	00020	?1010	00000	10001	1
lowryi	00000	10011	11020	?1010	00001	10000	1
thetisae	00001	11000	10020	?0010	10001	10000	0
bispinosa	02000	11020	01010	00010	00000	11111	1
tripartita	02000	10020	110?1	??000	1101?	?1111	0
kensleyi	02001	11020	110?1	??000	1101?	?1100	0
australis	10000	00000	10110	00000	0001?	?0000	1
matucana	00101	10000	10110	00000	0001?	??0??	1
poorei	12001	11000	00010	00010	00000	00000	1
islaya	11101	11000	10010	00001	00000	00000	1

Memoirs of the Museum of Victoria 56(1):235–244 (1997)

SPERMATOLOGICAL EVIDENCE SUPPORTS THE TAXONOMIC PLACEMENT OF THE AUSTRALIAN ENDEMIC HAIRY STONE CRAB, *LOMIS HIRTA* (DECAPODA: ANOMURA: LOMIDAE)

CHRISTOPHER C. TUDGE

Zoology Department, University of Queensland, Brisbane, Qld 4072, Australia

Present address: Crustacea, Museum of Victoria, 71 Victoria Crescent, Abbotsford, Vic. 3067, Australia

Abstract

Tudge, C.C., 1997. Spermatological evidence supports the taxonomic placement of the Australian endemic hairy stone crab, *Lomis hirta* (Decapoda: Anomura: Lomidae). *Memoirs of the Museum of Victoria* 56(1): 235–244.

An ultrastructural investigation of the spermatozoal morphology of the Australian endemic hairy stone crab, *Lomis hirta*, has revealed a unique sperm morphology supporting placement within its own family and superfamily. The spermatophore and spermatozoal morphology agree with morphological evidence that place this crab within the infraorder Anomura. the relatively unmodified spermatozoon suggests a basal origin for this taxon (with respect to other anomurans) and may be similar to the ancestral sperm type for many families in this infraorder. An independent lineage from the base of the Anomura has been previously suggested for *Lomis* on the basis of many morphological synapomorphies being shared with representatives from disparate families of the Anomura.

Introduction

Previous classifications of the decapod infraorder Anomura (Borradaile, 1907; Glaessner, 1969), recognised the four superfamilies, Thalassinoidea, Paguroidea, Galatheoidea and Hippoidea. More recently the thalassinoids have been excluded from the Anomura and the constituent anomuran superfamilies redefined as the Paguroidea, Lomoidea, Galatheoidea and Hippoidea (McLaughlin, 1983b; McLaughlin and Holthuis, 1985; Poore, 1994). McLaughlin and Holthuis stated that the term 'Anomala' was the more appropriate name for these constituent superfamilies (minus the thalassinoids), but the term 'Anomura' is more commonly used and has been adopted herein.

The superfamily Lomoidea contains the monospecific genus *Lomis* in the family Lomidae. This hairy stone crab is endemic to the rocky southern coasts of Australia and like its porcellanid relatives is very crab-like in appearance. *Lomis hirta* was first described as a hairy porcellanid by Lamarck (1818), then Bouvier (1894, 1895) considered it a symmetrical hermit crab, but this enigmatic crab has since been elevated to its own family and superfamily (McLaughlin, 1983a). Pilgrim (1965) reassessed the literature and examined fresh specimens and came to the conclusion that *Lomis* was a basal offshoot of the paguroids (along with the Pylochelidae) and that this basal position was indicative of its sharing many characters with the paguroids, galatheoids and thalassinoids. McLaughlin (1983a) similarly placed *Lomis* in a basal position, with respect to the Anomura, but had it evolving independently as a distinct evolutionary line from a common ancestral stock. *Lomis* continues to be problematic in regard to its relationship to the remainder of the Anomura (McLaughlin, 1983b; Martin and Abele, 1986; Richter and Scholtz, 1994).

The use of spermatozoal morphology for systematic, taxonomic and phylogenetic studies, initially pioneered by workers such as Koltzoff (1906) and Retzius (1909), has been successfully applied to the Crustacea (Jamieson, 1991) and in the Anomura and Brachyura in particular (Tudge, 1992, 1995a, b; Jamieson, 1994, 1995; and references therein). In this paper, the ultrastructure of the spermatozoa of *Lomis hirta* is described for the first time and the phylogenetic implications are discussed.

Methods

The single male specimen of *Lomis hirta* (Lamarck, 1818) was collected and fixed by Dr Gary Poore, Curator of Crustacea, Museum of Victoria, Australia from Flinders Reef, Victoria in September 1993. The male reproductive material (both testes including the ducts of the vasa deferentia) was removed from the crab and immediately fixed in cold glutaraldehyde for a

minimum of 2 hours at 4°C then posted to Brisbane at ambient temperature where the remainder of the fixation and embedding process was carried out.

Light microscopy

For light microscopy, glutaraldehyde-fixed sperm were viewed and photographed under an Olympus BH2 Nomarski interference contrast microscope. Micrographs were taken with an attached Olympus OM-2 camera.

Transmission electron microscopy

The standard fixation procedure (outlined below) for transmission electron microscopy was carried out in a Lynx -el. Microscopy Tissue Processor (Australian Biomedical Corporation, Ltd, Mount Waverley, Victoria, Australia), after the initial glutaraldehyde fixation and first phosphate buffer wash.

Portions of the testis (approximately 1 mm^3) were fixed in 3% glutaraldehyde in 0.2 *M* phosphate buffer (pH 7.2), with 3% sucrose added, for a minimum of 1 h at 4°C. They were washed in phosphate buffer (3 washes in 15 min), post-fixed in phosphate buffered 1% osmium tetroxide for 80 min; similarly washed in buffer and dehydrated through ascending concentrations of ethanol (40–100%). After being infiltrated and embedded in Spurr's epoxy resin (Spurr, 1969), thin sections (500–800 Å thick) were cut on a LKB 2128 UM IV microtome with a diamond knife. Sections were placed on carbon-stabilised colloidin-coated 200 µm mesh copper grids and stained (according to Daddow, 1986) in Reynold's lead citrate (Reynolds, 1963) for 30 s, rinsed in distilled water, then 6% aqueous uranyl acetate for 1 min, Reynold's lead citrate again for 30 s and a final rinse in distilled water. Micrographs were taken on an Hitachi H-300 transmission electron microscope at 80 kV.

Results

Spermatophore morphology

The spermatophores of *Lomis hirta* were only viewed in thick sections for transmission electron microscopy and the dimensions and morphology can only be estimated. The spermatophores are pedunculate, having the sperm-filled ampulla attached to a long thin stalk which in turn is connected to a basal plate or pedestal. The entire spermatophores have been estimated at approximately 300 µm in length and the ampullar dimensions at 100 µm long × 50 µm wide (Fig. 1A). The spermatophore wall (Fig. 1E), which constitutes the ampullar region of the spermatophore, is shown at the electron microscope level to be composed of a single homogeneously granular electron-dense layer (Fig. 2A) and to be of variable thickness.

Spermatozoal morphology

At the light microscope level the spermatozoa of *Lomis hirta* are irregular in outline, but basically globular in form with one to three small vertices which may be extended into microtubular arms (Figs 1B–E). Up to two microtubular arms have been observed in a single spermatozoon but sometimes three vertices are apparent (Fig. 1B). A ring-shaped acrosome vesicle is obvious on one surface of the sperm cell. The entire sperm cell can be up to 6µm in diameter (refer to Figs 2C and 4 throughout). In all figures the acrosomal or apical end of the spermatozoon is considered the anterior pole while the opposite, basal or nuclear end is posterior.

The acrosome vesicle is an irregular, inverted cup-shaped structure, approximately 2.5 µm wide, and is broadly penetrated posteriorly by the perforatorial chamber (Figs 2B, C; 3A, B, D). The acrosome vesicle wall is relatively thin and is composed of three distinctive zones. The most external region of the vesicle is made up of an interrupted layer of extremely electron-dense material embedded in a granular zone of lesser electron density. The extremely electron-dense material is interpreted to be the equivalent of the dense operculum, which normally caps the acrosome vesicle in anomurans, but its extension around the entire acrosome vesicle is unusual (Figs 2B, C; 3A, B, D, F). As mentioned this opercular layer is not a continuous, evenly distributed structure but forms an interrupted dense layer. The electron-dense, granular zone, here interpreted as the outer acrosome zone, surrounds the operculum and composes the majority of the thin acrosome vesicle. Occurring between this combined dense outer acrosome layer and the perforatorial chamber wall is a zone of similar granularity, the inner acrosome zone (Figs 2C; 3A, B, D-F). This latter zone is more electron-pale than the outer acrosome zone.

The perforatorial chamber invaginates into the acrosome vesicle from the posterior end and extends almost to the anterior most tip. It has a broad posterior region which tapers anteriorly to a blunt point (Figs 2C; 3A). The open, posterior end is slightly constricted when compared to the greatest width of the perforatorial chamber. The perforatorial chamber contents can be divided into two distinct regions. Internally there is a

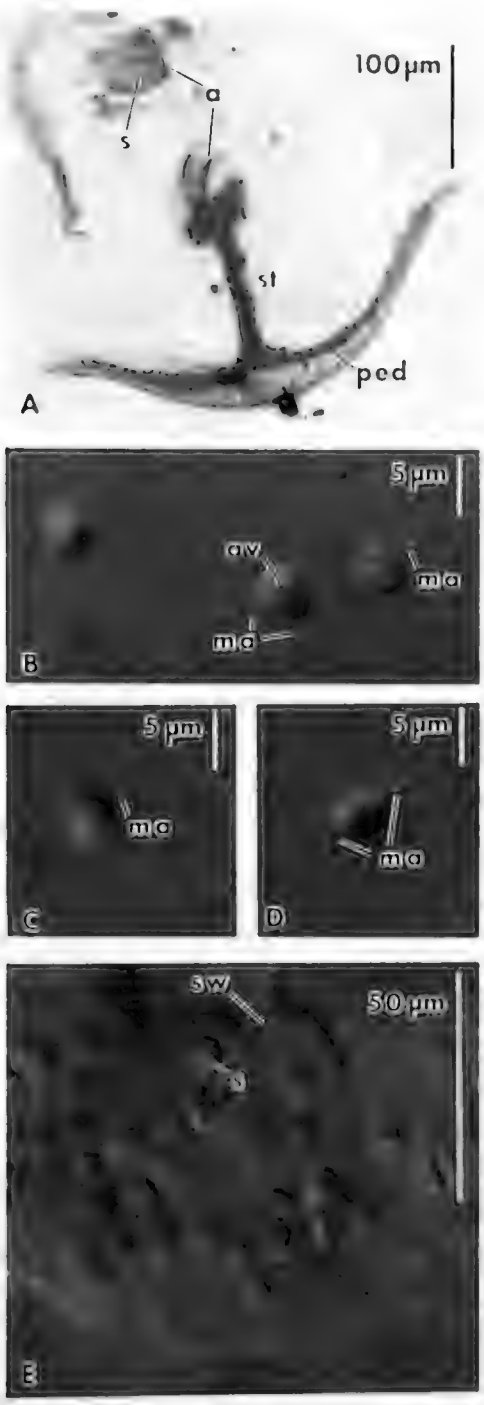


Figure 1. A-E *Lomis hirta* (Lomidae). A. Toluidine stained thick resin section showing partially sectioned spermatophore and contained spermatozoa. B-D. Light micrographs of spermatozoa showing one or two microtubular arms. E. Light micrograph of spermatozoa extruded from the vas deferens. Note the thick spermatophore wall. Scale bars as indicated (original).
a = ampulla; av = acrosome vesicle; ma = microtubular arm; ped = pedestal; s = spermatozoon; st = stalk; sw = spermatophore wall.

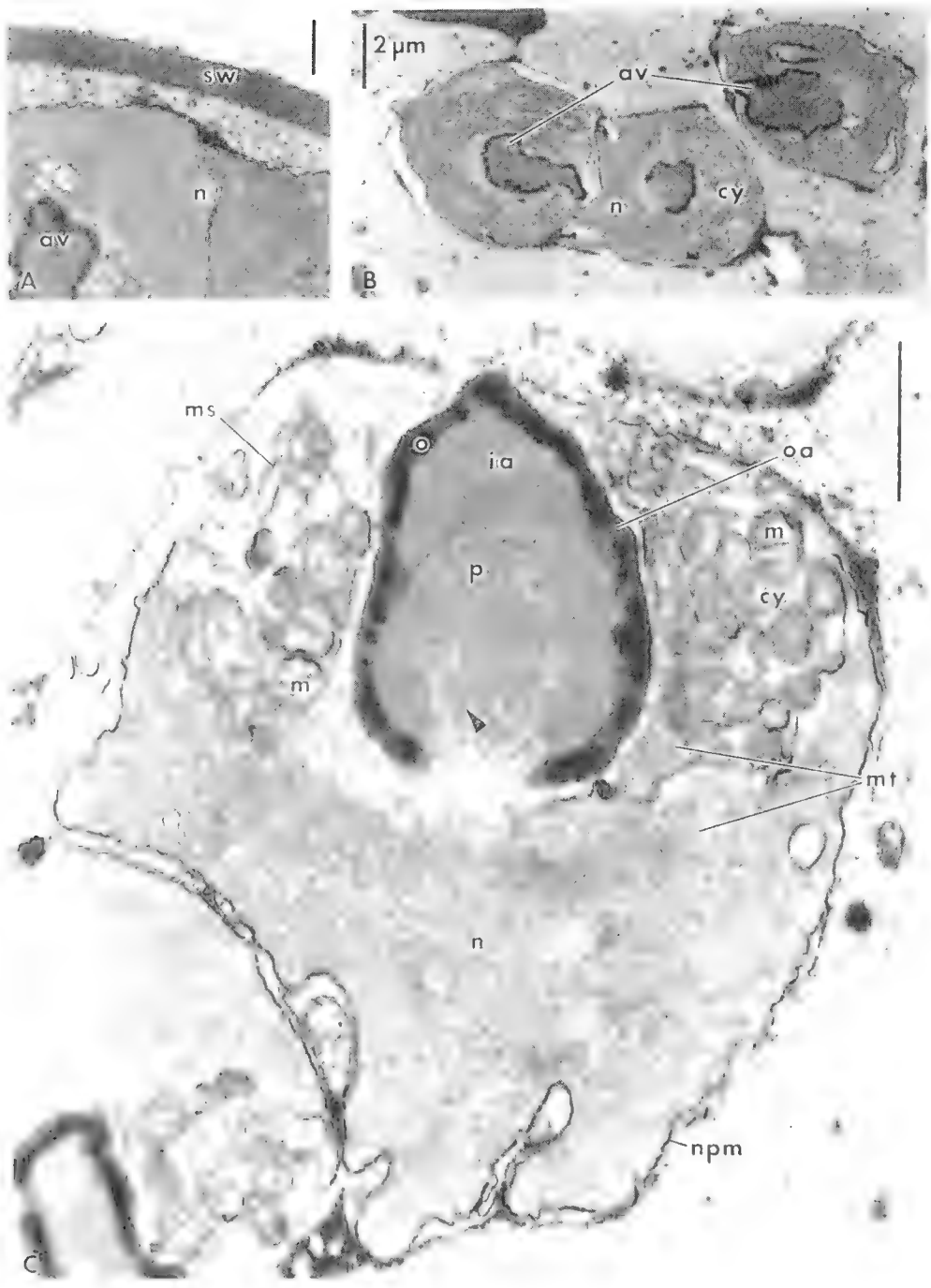


Figure 2. A–C *Lomis hirta* (Lomidae). Transmission electron micrographs of spermatozoa. A. Detail of spermatophore wall surrounding spermatozoa. B. Low power shot of three spermatozoa. C. Longitudinal section (LS) of a spermatozoon. Arrowhead indicates probable actin filaments. Scale bar = 1µm, except where indicated (original).

av = acrosome vesicle; cy = cytoplasm; ia = inner acrosome zone; m = mitochondrion; ms = membrane system; mt = microtubules; n = nucleus; npm = nucleo-plasma membrane; o = operculum; oa = outer acrosome zone; p = perforatorial chamber; sw = spermatophore wall.

core of longitudinally arranged striations, similar in appearance to actin filaments, while external to this is a homogeneous, finely granular region of moderate electron density (Figs 2C; 3A, B; 4). The posterior contents of the perforatorial chamber appear continuous with the cytoplasm beneath the acrosome vesicle.

The cytoplasm is very extensive and completely surrounds the acrosome vesicle, with the widest areas lateral to it (Figs 2C; 3D, F; 4). Anterior and posterior to the acrosome vesicle the cytoplasm is reduced to a thin layer with no obvious organelles present, except for a pair of centrioles which occur beneath the perforatorial chamber (Fig. 3C). Lateral to the acrosome vesicle the cytoplasm contains many organelles including an anterior region of loosely aggregated membranes and associated with these, many small spherical mitochondria, of which some appear cristate and others more degenerate (acristate) (Figs 2C; 3D, F). Scattered amongst these organelles are short and long bundles of microtubules which represent internal sections of the microtubular arms. Some bundles of microtubules are seen to extend into the nuclear material (Figs 3D, E).

The nucleus of the spermatozoa of *Lomis hirta* is irregular in form but retains a basically globular appearance (Figs 1B-D). It is composed of homogeneous, coarsely granular material of moderate electron density and is surrounded externally by a thickened nucleo-plasma membrane (Figs 2B, C; 3D; 4). No distinct membrane separates the cytoplasm from the nucleus. As previously mentioned small sections of the internal microtubular bundles are apparent in the nucleus (Fig. 2C).

Discussion

The paucity of information concerning the morphology of the spermatophores of *Lomis hirta* make it difficult to do more than speculate about their structure. It can be ascertained that the spermatophores are pedunculate (Fig. 1), and therefore typical of the Anomura studied to date (Tudge, 1991, 1995a). Until further morphological and ultrastructural studies are carried out on the spermatophore of this crab it will not be known if it has a spermatophore morphology that substantiates its morphological and spermatozoal uniqueness. The homogeneous, granular appearance of the spermatophore wall in *Lomis* (Fig. 2A) is similar to that recorded in the spermatophores of several pagurid hermit crabs, the parapagurid, *Sympagurus*, the galatheid, *Allogalathea*, the hippid, *Hippa*, and several porcellanid species (Tudge, 1995a).

The spermatozoon of *Lomis hirta* (Figs 2, 3, 4) possesses spermatozoal characters, such as microtubular arms (possible three?) and a concentrically arranged acrosome vesicle posteriorly penetrated by a perforatorial chamber, which justify its position in the Anomura but its spermatozoal morphology is distinct enough to warrant its own family and superfamily. Some of the characteristics of the spermatozoon of *Lomis* are considered unique. The variation in sperm cell shape shown within an individual is unusual and the amorphous form of the spermatozoa (Figs 1B-E; 2B), and to a lesser extent, the acrosome vesicle, distinguishes *Lomis* from other investigated anomurans (Hinsch, 1980, 1991; Tudge, 1992, 1995a, b). The small acrosome vesicle completely embedded in the cytoplasm has not been recorded for any other anomuran spermatozoon and is only approximated by that seen in the thalassinoids, *Axius* and *Callianassa* (Tudge, 1995a, b). The microtubular bundles, which appear to be concentrated in the cytoplasm, can also extend into the nucleus (Figs 2C; 3D-F). It is not known if these microtubular bundles, which are the bases of the microtubular arms, are cytoplasmic in origin (as in other investigated anomurans) or nuclear in origin (as seen in the spermatozoa of astacideans, palinurans and some thalassinoids and brachyurans). Although the sperm cells appear to have three vertices, only one or two microtubular arms have been seen on a single spermatozoon (Figs 1B-D) and it is not known if three microtubular arms is standard for *Lomis*. Three microtubular arms have been recorded for all investigated paguroids and galatheoids, with the exception of the Porcellanidae; which, with the hippids and thalassinoids, have four or more microtubular arms (Tudge, 1995a). Another unique feature of the spermatozoa of *Lomis* is the discontinuous electron-dense operculum, which surrounds the entire acrosome vesicle (Figs 2C; 2A, B, D-F) and not just the apical pole, as in all other investigated anomurans. An alternative theory concerning this structure is that it is not an operculum at all, but simply another dense zone of the acrosome vesicle. This possibility assumes that the operculum is therefore lacking which would similarly be an autapomorphy.

The Lomidae have been assigned to a basal position in the Anomura, based on adult somatic characters (Pilgrim, 1965; McLaughlin, 1983a, b; Martin and Abele, 1986; Richter and Scholtz,

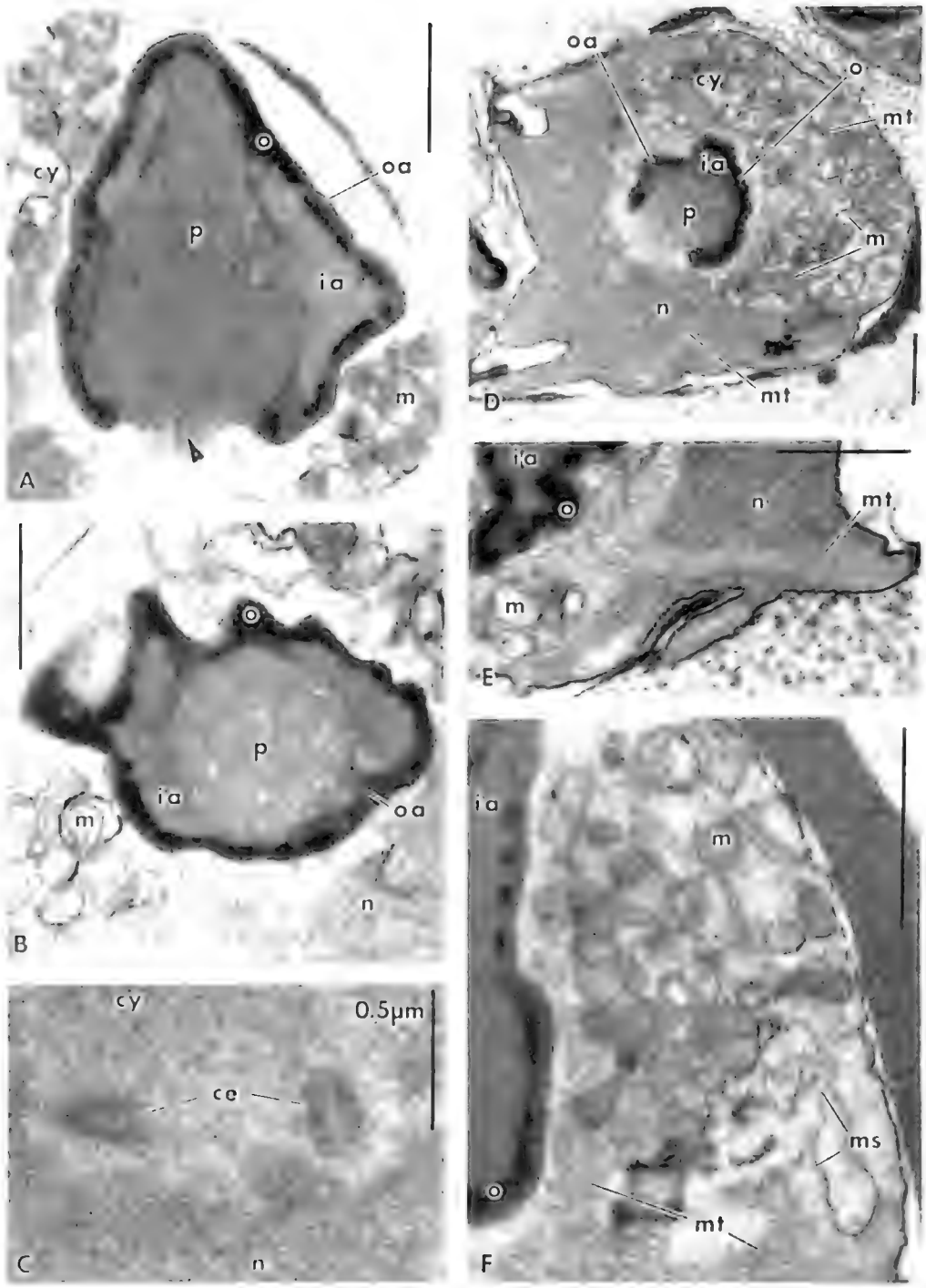


Figure 3. A–F. *Lomis hirta* (Lomidae). Transmission electron micrographs of spermatozoa. A. Detail of longitudinal section (LS) of acrosome vesicle. Arrowhead indicates probable actin filaments. B. Transverse section (TS) through acrosome vesicle. C. Detail of pair of centrioles. D. Oblique section through a spermatozoon showing long internal bundle of microtubules. E. Detail of microtubular bundle. F. Detail of cytoplasmic organelles. Scale bars = 1μm, except where indicated (original).
ce = centriole; cy = cytoplasm; ia = inner acrosome zone; m = mitochondrion; ms = membrane system; mt = microtubules; n = nucleus; o = operculum; oa = outer acrosome zone; p = perforatorial chamber.

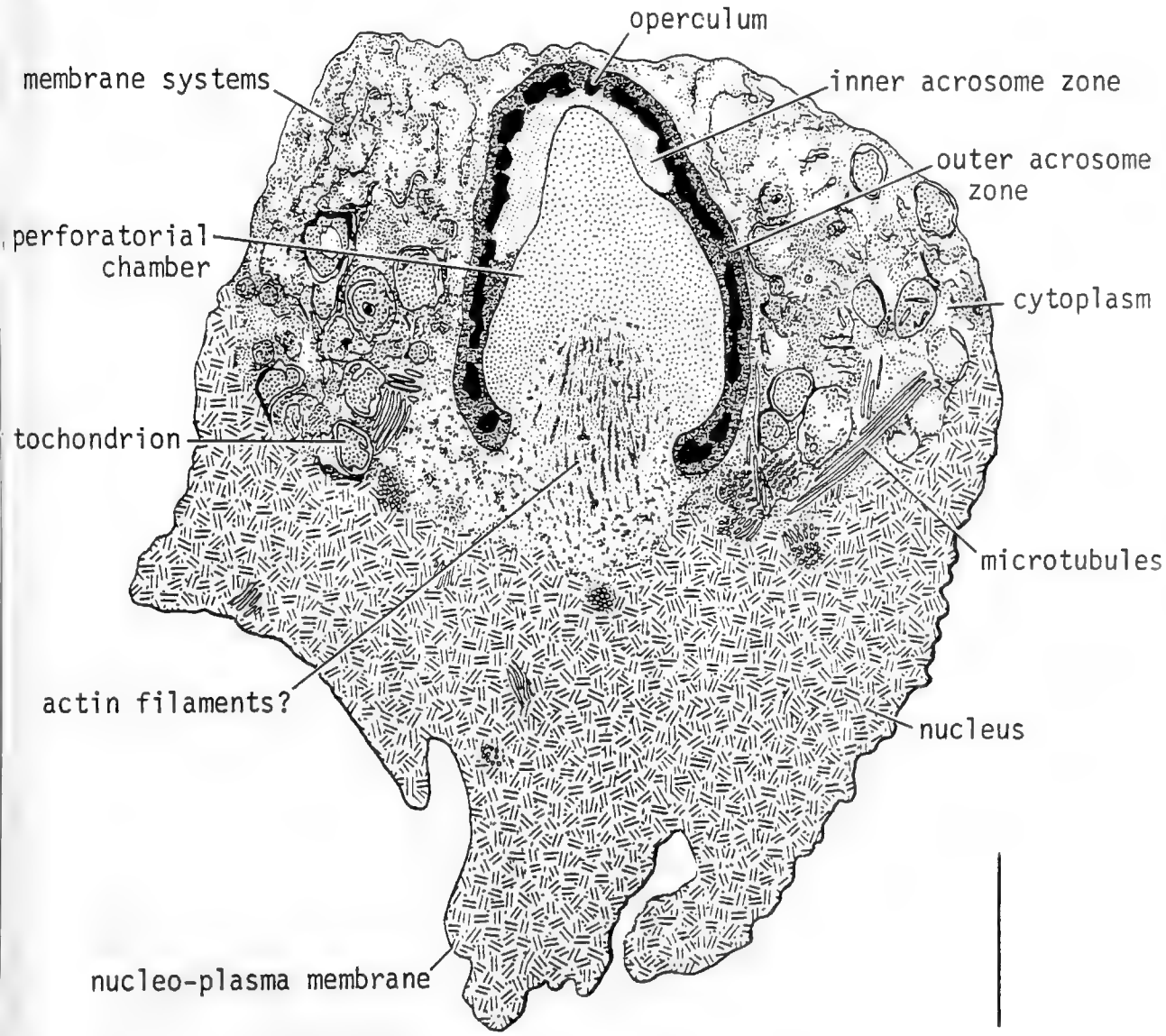


Figure 4. *Lomis hirta* (Lomidae). Semidiagrammatic longitudinal section of a spermatozoon, based on a tracing of a micrograph. Scale bar = 1μm (original).

1994), but there are differences between their conclusions. Not all authors dealt with all anomuran taxa. Pilgrim (1965) thought the family to be an early offshoot of the Anomura (within which he included the Thalassinidea). McLaughlin (1983a: 435) stated "the Lomidae represents a distinct evolutionary lineage within the Anomala, sharing the basic characters of the infraorder, but having evolved independently from the ancestral stock common to all of its major taxa", and decided it was a specialised and highly evolved taxon within the infraorder. Martin and Abele (1986) thought the Lomidae to be the sister family to the Lithodidae, together sister taxa to the Paguroidea. Richter and Scholtz (1994) placed the Lomidae as the sister group of the Paguroidea (including Lithodidae in the latter superfamily) based on uropod morphology.

The fact that the phylogenetic relationship of *Lomis* has sparked such debate and still remains unclear is reflected in its lack of recognisable morphological apomorphies and its sharing of numerous synapomorphic characters with more remotely related anomuran taxa. Like many other families in the Anomura (the Hippidae, Lithodidae, Pylochelidae and Aeglidae, for example) the Lomidae is only represented as fossils from the Recent (Glaessner, 1969) and therefore palaeontological evidence of their evolution is limited.

The spermatozoal data supports the views presented by Pilgrim (1965) and McLaughlin (1983a) that *Lomis* is basal to, or a separate lineage from, the ancestor of the Anomura + Thalassinidea (Pilgrim, 1965) or Anomala (anomurans excluding thalassinideans) (McLaughlin, 1983a). This same spermatozoal data is less supportive of the view expressed by Richter and Scholtz (1994) that the Lomidae is the sister taxon of the Paguroidea and does not support the close relationship between *Lomis* and lithodids suggested by Martin and Abele (1986). Although the spermatozoal morphology in the Lithodidae is only described from light microscope drawings of *Lithodes maja* (see Retzius, 1909), it can be clearly ascertained that the overall spermatozoal morphology is unlike that of *Lomis* and more similar to investigated paguroids (Tudge, 1992, 1995a, b). A close link between *Lomis* and lithodids seems unlikely on the present spermatological evidence. Poore (1994) clearly showed a sister group relationship between the Thalassinidea and the Anomura based on morphological characters but the position of *Lomis* in this analysis is not known as it was not one of the anomuran taxa used. The spermatozoa of *Lomis* appear to share several characters in common with two previously investigated thalassinoids (*Axius* and *Callianassa*) but a detailed comparison of spermatozoal morphology between the Lomoidea and Thalassinoidea will have to wait pending a more thorough investigation into the spermatozoal form and diversity within the latter superfamily.

The ancestor of some or all of the anomuran families may have had a spermatozoal morphology very similar to that of *Lomis* and the diversity (admittedly restricted by a conservative ground-plan) of sperm morphology encountered in extant families of the Anomura could have emerged through modification of this ancestral sperm form. It is conceivable that the anomuran spermatozoal type (in the Paguroidea in particular) developed from a lomid-like morphology by 1) increasing the size and complexity of the acrosome vesicle, 2) restricting the operculum to the apical pole, 3) shifting the acrosome vesicle to a superior position on the cytoplasm and 4) establishing three, equidistant microtubular arms. The lomid lineage may have independently evolved from this ancestor but retained the spermatozoal morphology which was ancestral to the remainder of the Anomura. The lack of distinct morphological apomorphies, the sharing of morphological characters with as many as nine other anomuran families and the newly presented spermatological evidence, indicating a unique and particularly unmodified sperm morphology, would appear to vindicate a basal or ancestral position of *Lomis* in relation to the remainder of the Anomura.

Acknowledgments

The author wishes to thank Dr Gary Poore (Museum of Victoria) for collecting and undertaking the initial fixation of the specimen of *Lomis hirta*. Mrs Lina Daddow (Zoology Department, The University of Queensland) is thanked for technical assistance with electron microscopy. The support and careful reading of the manuscript by Prof. Barrie Jamieson (Zoology Department, The University of Queensland) is gratefully acknowledged.

References

Borradaile, L.A., 1907 On the classification of the decapod crustaceans. *Annals of the Magazine of Natural History* 19: 457–486.

Bouvier, E.L., 1894. Sur les caractères et l'évolution des Lomisinés, nouveau groupe de Crustacés anomoures. *Comptes Rendus Hebdomadaires de Séances de l'Académie des Sciences, Paris* 118: 1353–1355.

Bouvier, E.L., 1895. Recherche sur les affinités des *Lithodes* et des *Lomis* avec les Pagurides. *Annales des Science Naturelles, Zoologie* (Serie 7) 18: 157–213.

Daddow, L.Y.M., 1986. An abbreviated method of the double lead stain technique. *Journal of Submicroscopic Cytology* 18: 211–224.

Glaessner, M.F., 1969. Decapoda. Pp. R399–R533 in: Moore, R.C. (ed.), *Treatise on invertebrate paleontology, Arthropoda 4. Part R. vol. 2.* Geological Society of America and University of Kansas Press: Lawrence.

Hinsch, G.W., 1980. Spermiogenesis in *Coenobita clypeatus*, I. Sperm structure. *International Journal of Invertebrate Reproduction* 2: 189–198.

Hinsch, G.W., 1991. Ultrastructure of the sperm and spermatophores of the anomuran crab *Pleuroncodes planipes*. *Journal of Crustacean Biology* 11: 17–22.

Jamieson, B.G.M., 1991. Ultrastructure and phylogeny of crustacean spermatozoa. *Memoirs of the Queensland Museum* 31: 109–142.

Jamieson, B.G.M., 1994. Phylogeny of the Brachyura with particular reference to the Podotremata: evidence from a review of spermatozoal ultrastructure (Crustacea, Decapoda). *Philosophical Transactions of the Royal Society of London B* 345: 373–393.

Jamieson, B.G.M., 1995. Phylogeny of the Brachyura: evidence from spermatozoal ultrastructure (Crustacea, Decapoda). In: Jamieson, B.G.M., Ausio, J. and Justine, J.-L. (eds.), *Advances in spermatozoal phylogeny and taxonomy. Mémoires du Muséum National d'Histoire Naturelle (Paris)* 166: 265–283.

Koltzoff, N.K., 1906. Studien über die gestalt der zelle. I. Untersuchungen über die spermien der decapoden, als einleitung in das problem der zellengestalt. *Archiv fur Mikroskopische Anatomie und Entwicklungs-Geschichte* 67: 364–572.

Lamarck, J., 1818. Histoire naturelle des animaux sans vertèbres, présentant les caractères généraux et particuliers de ces animaux, leur distribution, leurs classes, leurs familles, leurs genres, et la citation des principales espèces qui s'y rapportent; prècèdée d'une introduction offrant la détermination des caractères essentiels de l'animal, sa distinction du végétal et des autres corps naturels, enfin, l'exposition des principes fondamentaux de la zoologie. 5: 1–612.

Martin, J.W. and Abele, L.G., 1986. Phylogenetic relationships of the genus *Aegla* (Decapoda: Anomura: Aeglidae), with comments on anomuran phylogeny, *Journal of Crustacean Biology* 6: 576–616.

McLaughlin, P.A., 1983a. A review of the phylogenetic position of the Lomidae (Crustacea: Decapoda: Anomala). *Journal of Crustacean Biology* 3: 431–437.

McLaughlin, P.A., 1983b. Hermit crabs — are they really polyphyletic? *Journal of Crustacean Biology* 3: 608–621.

McLaughlin, P.A. and Holthius, L.M., 1985. Anomura versus Anomala. *Crustaceana* 49: 204–209.

Pilgrim, R.L.C., 1965. Some features in the morphology of *Lomis hirta* (Lamarck) (Crustacea: Decapoda) and a discussion of its systematic position and phylogeny. *Australian Journal of Zoology* 13: 545–557.

Poore, G.C.B., 1994. A phylogeny of the families of Thalassinidea (Crustacea: Decapoda) with keys to families and genera. *Memoirs of the Museum of Victoria* 54: 79–120.

Retzius, G., 1909. Die spermien der Crustaceen. *Biologische Untersuchungen* 14: 1–54.

Reynolds, E.S., 1963. The use of lead citrate at high pH as an electron opaque stain in electron microscopy. *Journal of Cell Biology* 17: 208–212.

Richter, S. and Scholtz, G., 1994. Morphological evidence for a hermit crab ancestry of lithodids (Crustacea, Decapoda, Anomala, Paguroidea). *Zoologische Anzeiger* 233: 187–210.

Spurr, A.R., 1969. A low viscosity epoxy-resin embedding medium for electron microscopy. *Journal of Ultrastructure Research* 26: 31–43.

Tudge, C.C., 1991. Spermatophore diversity within and among the hermit crab families, Coenobitidae, Diogenidae and Paguridae (Paguroidea, Anomura, Decapoda). *Biological Bulletin* 181: 238–247.

Tudge, C.C., 1992. Comparative ultrastructure of hermit crab spermatozoa (Decapoda: Anomura: Paguroidea). *Journal of Crustacean Biology* 12: 397–409.

Tudge, C.C., 1995a. *The ultrastructure and phylogeny of anomuran crab spermatozoa.* Ph.D. Thesis, Zoology Department, University of Queensland, Brisbane, Australia. 346 pp.

Tudge, C.C., 1995b. Ultrastructure and phylogeny of the spermatozoa of the infraorders Thalassinidea and Anomura (Decapoda, Crustacea). In: Jamieson, B.G.M., Ausio, J. and Justine, J.-L. (eds.), *Advances in spermatozoal phylogeny and taxonomy. Mémoires du Muséum National d'Histoire naturelle (Paris)* 166: 251–263.

Memoirs of the Museum of Victoria 56(1):245–253 (1997)

A REMARKABLE NEW PYGMY SEAHORSE (SYNGNATHIDAE: *HIPPOCAMPUS*) FROM SOUTH-EASTERN AUSTRALIA, WITH A REDESCRIPTION OF *H. BARGIBANTI* WHITLEY FROM NEW CALEDONIA

MARTIN F. GOMON

Department of Natural Sciences, Museum of Victoria, GPO Box 666, Melbourne, Vic. 3000, Australia

Abstract

Gomon, M.F., 1997. A remarkable new pygmy seahorse (Syngnathidae: *Hippocampus*) from south-eastern Australia, with a redescription of *H. bargibanti* Whitley from New Caledonia. *Memoirs of the Museum of Victoria* 56(1): 245–254.

A new syngnathid fish, *Hippocampus minotaur*, is described from southeastern Australia. It can be distinguished from congeners by its prominent head and distinctive thick 'neck', tiny dorsal fin with only 7 rays, low number of pectoral fin rays (11), low number of trunk segments (8), lack of definition of trunk and caudal segments and lack of inferior and median ventral trunk ridges. It appears to be restricted to mid-continental shelf depths. A complete description of the New Caledonian *H. bargibanti* Whitley, 1970 is also presented.

Introduction

Species of *Hippocampus* (family Syngnathidae), widely referred to as seahorses, are extremely variable (e.g., Ginsburg, 1937). Their well publicised male brooding habits have been responsible for a low rate of dispersal and consequent clinal variation in at least some populations. In such cases, subpopulations have occasionally been recognised as separate species. Although a comprehensive generic revision of *Hippocampus* is still to come, the perception that the genus is less diverse and species are more widely distributed than long thought is obvious from treatments that have appeared in regional studies over the last 15 years (e.g., Vari, 1982, Dawson, 1986a, 1986b, 1994). Nevertheless, previously unrecognised taxa do occur. One example is an extraordinary, diminutive, southeastern Australian species which occurs at depths that are generally greater than those inhabited by its sympatric congeners. A description of the species is presented here, bringing the number of currently recognised Australian representatives of the genus to seven. The new species is similar in many regards to the New Caledonian *H. bargibanti* Whitley, 1970, described in a brief note in the abstracts of an ordinary meeting of the Linnaean Society of New South Wales. A detailed description of that species is also provided.

Methodology follows that of Vari (1982), except that a camera lucida on a binocular microscope was used to make tracings from which proportional measurements were recorded. Because of the fleshy nature of the two species treated and the reduction in ossification of their trunk and tail segments, it is not possible to report the numbers of segments based on external features, such as tubercles on the lateral trunk ridge. A comparison of body segments, determined as described by Vari (1982), with vertebrae in *H. abdominalis* and *H. breviceps* revealed that the first two precaudal vertebrae are not represented by tubercles on the lateral trunk ridge. The numbers of trunk segments as reported by previous workers is therefore assumed to be two fewer than the numbers of precaudal vertebrae. The numbers of tail segments in the two species are equal to the numbers of caudal vertebrae. In the following descriptions, the numbers of trunk and tail segments reported were calculated on the basis of the numbers of precaudal and caudal vertebrae observed on radiographs. The descriptions of the two species are of the holotype and lectotype; variations observed in paratypes, paralectotypes and other material are noted in parentheses. All body lengths are reported as millimeters total length (TL) as recorded by Vari (1982). The snout, orbit and post orbital lengths are compared with the head length (HL).

Specimens are from the collections of the Australian Museum, Sydney (AMS) and the Museum of Victoria, Melbourne (NMV). In addition to specimens of *H. bargibanti* and *H. minotaur* mentioned in the descriptions below, the following material was examined for this study: *H. abdominalis*: NMV A2899 (42.6, immature male?) Victoria, Port Phillip Bay,

Rye; NMV A8945 (60.5, female) South Australia, Point Sinclair; NMV A8975 (56.1, male) Victoria, off Lakes Entrance; NMV A14219 (12: 13.2–14.5, juveniles) Victoria, Port Phillip Bay, aquarium bred; *H. angustus*: AMS I.35463–001 (18.2, juvenile) Western Australia, entrance to Swan Esturary; *H. breviceps*: NMV A2898 (3: 23.2–28.6, juveniles) Victoria, Port Phillip Bay, Rye; NMV A11099 (48.4, male) Victoria, southern Port Phillip; NMV A11469 (2: 45.8–57.2, male and female) Victoria, Port Welshpool Jetty; NMV A14180 (2: 15.4–22.9, juveniles) Victoria, Western Port; *H. whitei*: AMS I.28289–002 (16.6, juvenile) New South Wales, Lake Macquarie.

Hippocampus minotaur sp. nov.

bullneck seahorse

Figures 1, 2a, 3a

Material examined. Holotype. NMV A192 (48.7, male), Australia, New South Wales, off Eden, 35–40 fm (64–73 m), 30 Dec 1960, Danish seine trawl, R. Slack-Smith.

Paratypes. NSW. AMS IA.3509 (42.2, female), coast of NSW, trawled; AMS IA.3560 (52.6, female), 8 mi E of Eden, 50–60 fm (91.5–109.8 m).

Vic. NMV A14161 (19.2, juvenile), Bass Strait, 38 km SW of Cape Paterson, 38°56.4′S, 145°16.6′E, 70 m, fine sandy bottom, 12 Nov 1981, RV *Tangaroa*, R. Wilson.

Diagnosis. Dorsal fin rays 7; pectoral fin rays 11; anal fin rays 4; no exaggerated constriction dividing head and body; head and body extremely fleshy without recognisable bony segments, spines or other ornamentation; ventral trunk ridges undeveloped.

Description. Head prominent, rather immobile, maintained at an angle of about 90° to axis of trunk; head length 16.4 (16.7–21.3)% TL; snout very short, 29.3 (28.0–31.1)% HL; orbital diameter 25.6 (20.3–24.4)% HL; postorbital length 46.3 (47.7–48.8)% HL; dermal flaps absent; coronet low, appearing as a shallow mound; 'neck' extremely deep (= broad), only slightly shallower than head depth; head and body very fleshy, segments indistinct in fresh material, devoid of prominent spines or tubercles; fleshy filaments absent; ventral portion of trunk segments incomplete; inferior trunk ridge and median ventral trunk ridge absent; other trunk and tail ridges very poorly developed, remnants of lateral trunk and inferior tail ridges not perceptibly confluent, remnants of superior trunk and tail ridges overlapping on ultimate trunk segment; trunk segments 8; caudal segments 41; first caudal segment quadrangular; last trunk segment incomplete; trunk short, 31.0 (31.3–36.4)% TL; abdomen very broad, 19.7 (14.6–15.9)% TL; pouch in brooding males occupying most of abdominal cavity, positioned opposite last two trunk segments and first five caudal segments; dorsal fin tiny, with 7 rays, base extremely short, 2.0 (2.6–3.8)% TL, situated at juncture of last trunk segment and first caudal segment, totally confined to posterior and anterior portions of these segments respectively (subdorsal rings 2); pectoral fin rays 11; anal fin rays 4, vestigial or absent in adults. Colour in preservative, mostly cream, speckled with tiny brown dots with cream centres (remaining specimens mostly brownish). Life colors unavailable.

Etymology. Minotaur (noun in apposition), a mythical creature with the head of a bull and the body of a human, referring to the contrasting massive bull-like head and graceful trunk and tail of this species.

Distribution and ecology. Specimens for which detailed collection information is available came from off Eden, New South Wales, and southwest of Cape Paterson, Victoria. A. Steffe (personal communication) has indicated that the species has also been taken in environmental monitoring surveys off Wollongong, NSW. One of the paratypes was recorded as having been collected on a bottom with 'fine sand'.

Remarks. The prominent head with very short snout, relatively thick 'neck' region and tiny dorsal fin supported by only seven rays make this diminutive species unmistakable. Its very low numbers of dorsal and pectoral fin rays in comparison with other recognised species of the genus (Fig. 4) approach those of several other 'pygmy' species, such as the Western Atlantic *H. zosterae* Jordan and Gilbert, 1882, the Japanese *H. coronatus* Temminck and Schlegel, 1850, and the New Caledonian *H. bargibanti* Whitley, 1970. Similarities between some of these species may be paedomorphic. Like two of its three sympatric congeners, *H. minotaur* has a high number of caudal segments, its value overlapping those of *H. breviceps* and being just less than in *H. abdominalis*. *Hippocampus abdominalis* has the highest numbers of caudal segments in the genus. The number in *H. minotaur*, however, does overlap with those of the Chinese *H. tatakurae* and the Indo-Pacific *H. trimaculatus*.

Hippocampus minotaur shares with the unusual *H. bargibanti* the lack of any obvious demarcation of body segments and a great reduction of

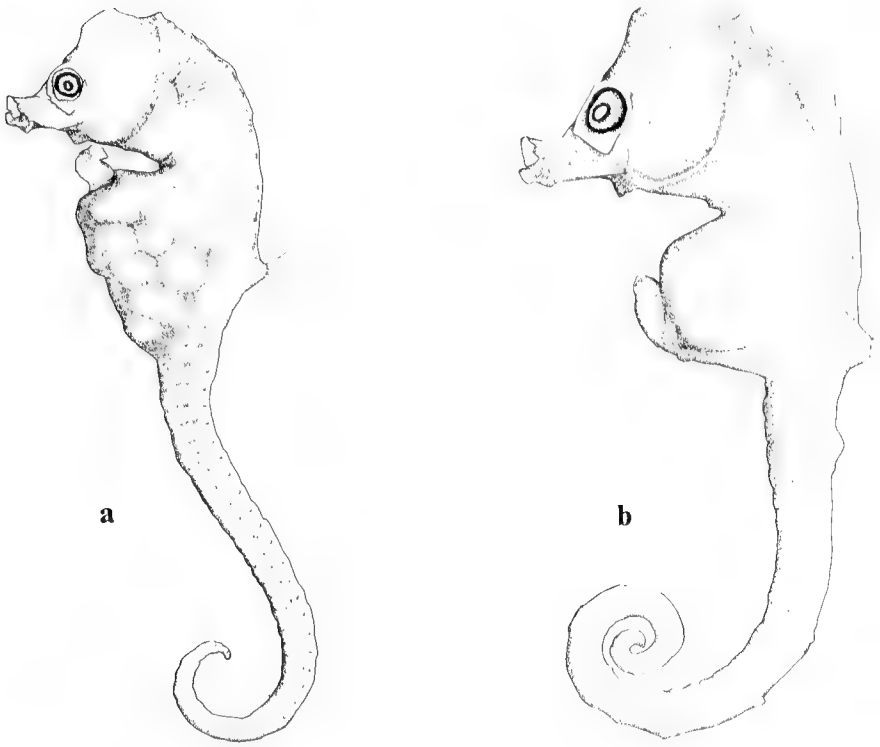


Figure 1. *Hippocampus minotaur* sp. nov. a, holotype, NMV A192, male, 48.7 mm TL, and b, paratype, AMS IA.3509, female, 42.2 mm TL. Scale = 5 mm.

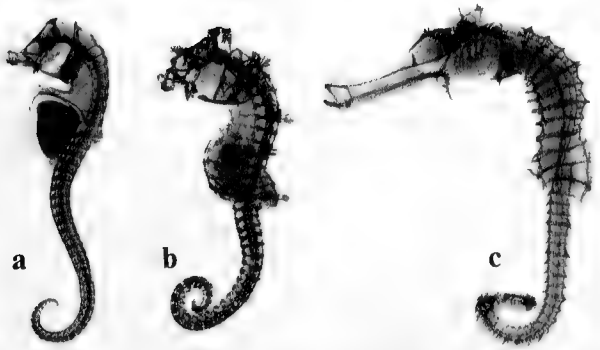


Figure 2. Radiographs: a, *Hippocampus minotaur* sp. nov., holotype, NMV A192, male, 48.7 mm TL; b, *Hippocampus bargibanti* lectotype, AMS I.15418–002, 20.9 mm TL; c, *Hippocampus breviceps* NMV A2898, 27.4 mm TL.

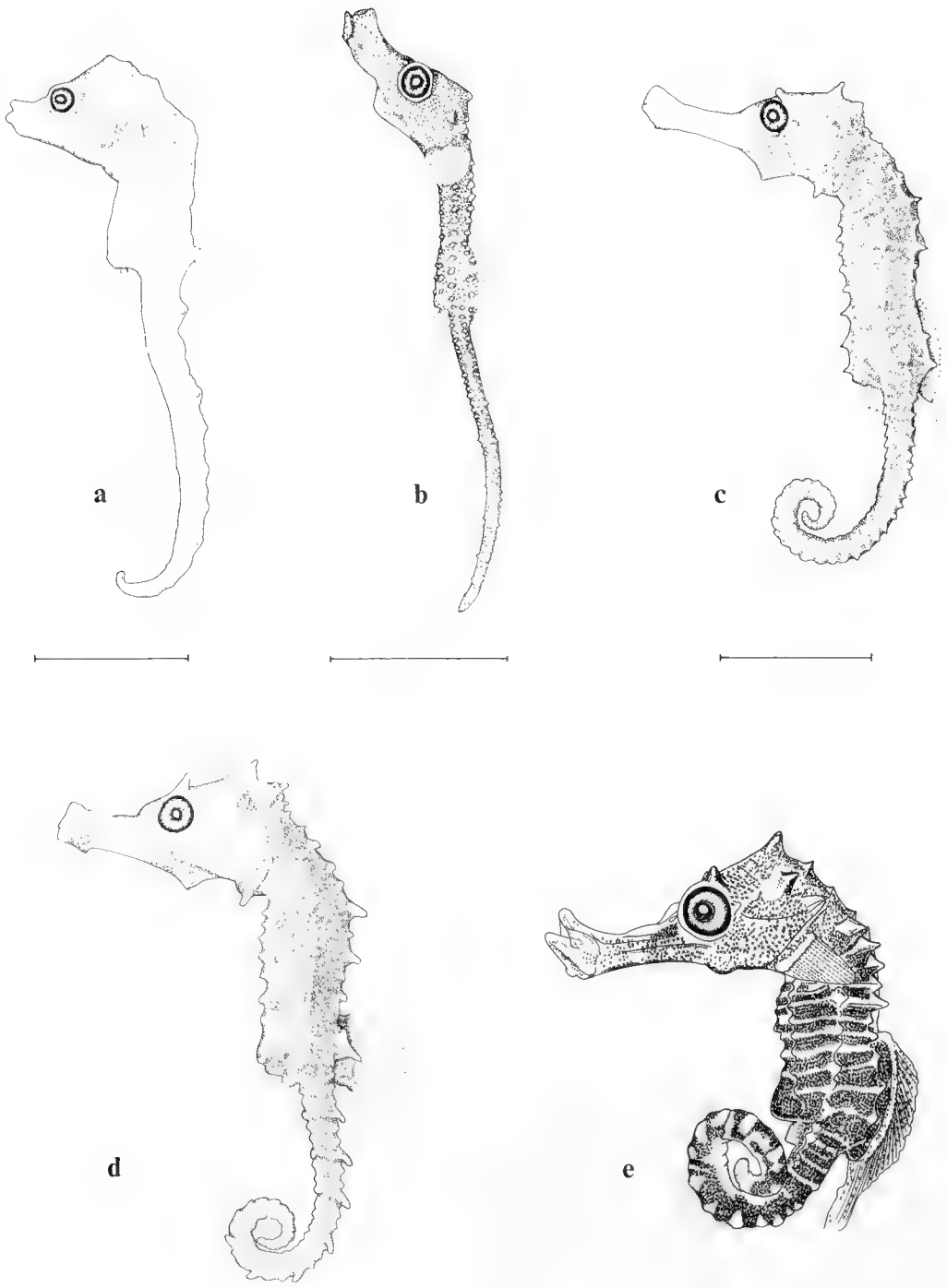


Figure 3. Juveniles of temperate Australian species of *Hippocampus*: a, *Hippocampus minotaur* sp. nov., paratype, NMV A14161, 19.2 mm TL; b, *Hippocampus abdominalis*, NMV A14219, 14.0 mm TL; c, *Hippocampus breviceps*, NMV A14180, 22.9 mm TL; d, *Hippocampus whitei*, AMS I.28289–002, 16.6 mm TL; e, *Hippocampus angustus*, AMS I.35463–001, 18.2 mm TL. Scale = 5 mm.

both ventral trunk ridges and the lower portions of trunk segments, as well as an abbreviated snout, a reduction in the constriction separating the head from the body, and small size. *Hippocampus minotaur* and *H. bargibanti* differ from other previously described members of the genus in having the ventral portions of the trunk segments sufficiently reduced that they no longer have the segmented appearance typical of syngnathids (Fig. 2c). In *H. bargibanti* dermal ossifications on the belly are reduced to unconnected star-like plates (Fig. 2b). In *H. minotaur*, dermal ossifications are absent in this region, the only visible remnant of the posterior trunk segments ventrally in radiographs of females being a crescentic process curving posteriorly and ventrally from the position of the lateral trunk ridge of the last trunk segment. This may provide structural support to the posterior margin of the 'belly'. In the holotype of this species, a brooding male, the ossified process curves anteriorly and ventrally and separates the anterior margin of the brood pouch from the thoracic cavity. The level of the process in this specimen is near the centre of the second penultimate trunk segment (Fig. 2a). The space remaining for abdominal organs in the holotype is in a narrow strip of the trunk anteriorly.

Despite the disparity in their number of caudal segments, the modifications shared by *H. minotaur* and *H. bargibanti* support the hypothesis that they are sister species. Other superficial features may provide further evidence for such a relationship. In the paratypes of *H. minotaur*, noticeable bud-like processes somewhat reminiscent of those on the body of *H. bargibanti* are present on the dorsal surface of the tail. In the latter, the bumps closely resemble the polyps of the gorgonian coral (*Muricella* sp.) to which it has been observed to cling and apparently which it mimics in life (Whitley, 1970). The structures in *H. minotaur* may provide a similar form of camouflage, especially if the species is found in association with southern soft corals. Unfortunately, collection information for type specimens of *H. minotaur* is insufficiently detailed to be able to assess this possibility.

Even at a very small size, *H. minotaur* is readily separable from its sympatric congeners by its very short snout and absence of readily recognisable body segments or associated spinous ornamentation (Fig 3a). The shortsnout seahorse *H. breviceps* (Fig. 3c) at this size has an extremely elongate snout, comparable with those in *H. abdominalis* (Fig. 3b), *H. whitei* (Fig. 3d) and the warm temperate Western Australian *H. angustus* (Fig. 3e), even though the last three species have a comparatively longer snout than *H. breviceps* in adults. *Hippocampus abdominalis*, *H. breviceps* and *H. whitei*, which co-occur in southeastern Australian are easily separated at all sizes by their dorsal fin ray and caudal segment counts. *Hippocampus angustus* is separable from *H. abdominalis* and *H. breviceps* by caudal segment counts (Fig. 4).

Hippocampus bargibanti Whitley, 1970

Figures 2b, 5, 6

Hippocampus bargibanti Whitley, 1970: 294. — Burgess et al., 1988: pl.79, bottom.

Material examined. Lectotype: AMS I.15418–002 (20.9, female), New Caledonia, Nouméa, on gorgonian coral *Muricella* sp., 30 m, July 1969, collected by Georges Bargibant.

Paralectotype: AMS I.15418–001 (19.5 mm TL, female), same collection information as lectotype.

Other specimens: New Caledonia. AMS I.15997–001 (2: 21.4–22.0, male and female), off Nouméa. Canal Woodin, 20–25 m, 26 Sep 1971, S. Catala; AMS I.19834–001 (24.2, female), Nouméa lagoon, Jul 1969.

Diagnosis. Dorsal fin rays 14; pectoral fin rays 10; anal fin absent in adults; very weak constriction separating head and body; head and body extremely fleshy mostly without recognisable bony segments, body ornamentation in the form of prominent bulbous tubercles; ventral trunk ridges poorly developed.

Description. Head moderately large, with restricted movement, held at an angle of about 90° to axis of trunk; head length 19.6 (16.9–19.2)% TL; snout extremely short 34.1 (24.4–28.6)% HL, with dorsal constriction midway between tip and eye giving tip a bulbous appearance; orbital diameter 26.8 (19.5–24.4)% HL; postorbital length 61.0 (51.4–61.0)% HL; prominent fleshy bulbous spine above each eye, smaller crest-like spine on dorsal midline of head in front of eye; small blunt spine centrally on cheek below posterior half of eye; slightly larger blunt spine on ventral midline of head below posterior margin of eye; corona prominent with broad base and broadly flattened apex; prominent fleshy bulbous spine on each side of head below forward half of corona, level with upper edge of eye; slightly smaller spine immediately preceding lower half of pectoral fin base; extremely prominent fleshy bulbous spines based on dorsal trunk ridge at about first, fifth and twelfth segments, the last pair on either side of dorsal fin base between seventh and tenth rays; fleshy bulbous

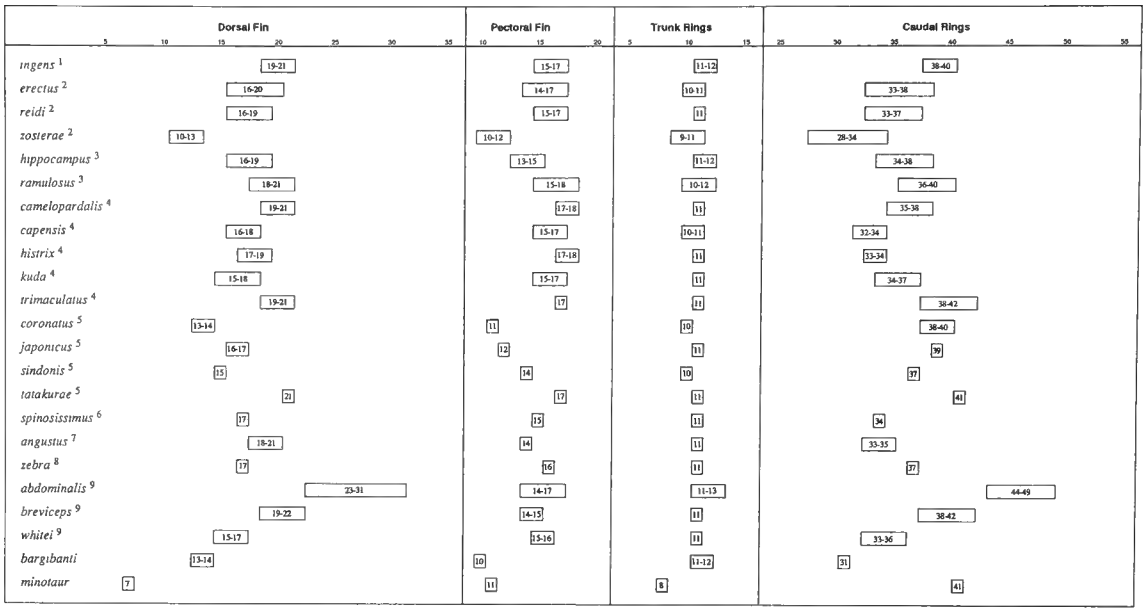


Figure 4. Selected meristic values for species of *Hippocampus*. Meristic values shown came from: 1 Ginsburg, 1937, 2 Vari, 1982, 3 Dawson, 1986b, 4 Dawson, 1986a, 5 Masuda et al., 1984, 6 Weber and de Beaufort, 1922, 7 Günther, 1870, 8 Whitley, 1964 and 9 Dawson, 1994.

Figure 5. *Hippocampus bargibanti* Whitley, 1970, lectotype, AMS I.15418-002, 20.9 mm TL, female. Scale = 5 mm.

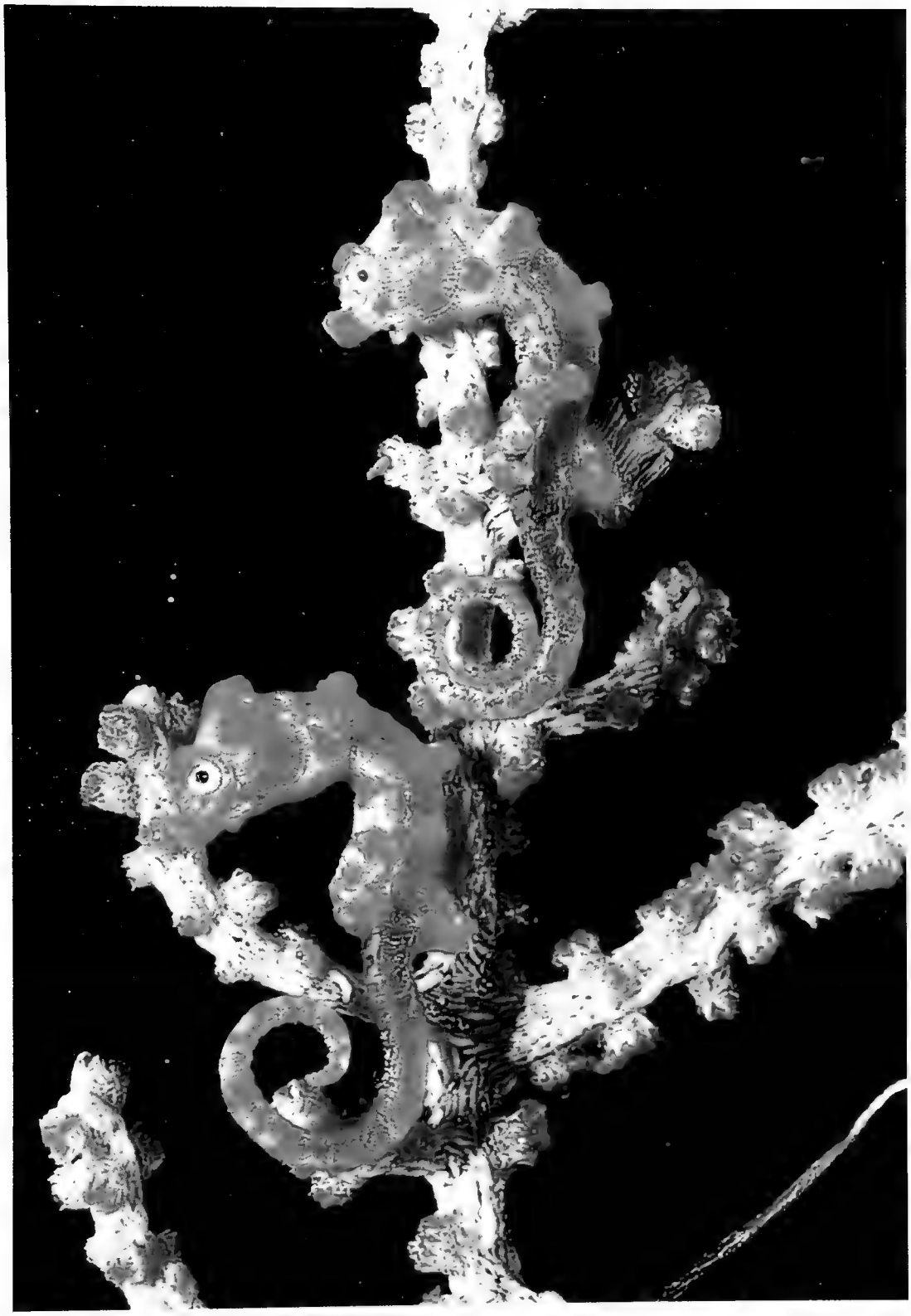


Figure 6. *Hippocampus bargibanti* Whitley, 1970, on *Muricella* sp.

process on lateral trunk ridge at eighth trunk segment; similar process immediately ventrad; lower, broader process on ventral profile of 'belly' flanking anus on last trunk segment; several smaller, low, blunt, fleshy spines scattered on belly; dermal filaments absent; 'neck' broad, depth at constriction only slightly less than head depth; ventral portion of trunk segments incomplete; inferior trunk ridge and median ventral trunk ridge reduced to star-shaped, embedded, dermal ossifications anteriorly, ossifications forming structural bases for low fleshy spines on belly, posteriormost two trunk segments more completely ossified; other trunk and tail ridges very poorly developed, remnants of lateral trunk and inferior tail ridges not perceptively confluent, remnants of superior trunk and tail ridges apparently overlapping on ultimate trunk segment; trunk segments 12; caudal segments 31; first caudal segment quadrangular; last trunk segment incomplete; trunk of moderate length 43.1 (36.4–41.0)% TL; abdomen broad, 15.3 (12.4–20.6)% TL; pouch structure unknown; dorsal fin small, with 14 rays, base distinctly angled, the anterior end positioned much more ventrally than posterior end, length 11.0 (9.1–9.8)% TL, situated above last 2.5 trunk segments and first caudal segment (subdorsal rings 3.5); pectoral fin rays 10; anal fin rays absent in adults. Colour in preservative mostly cream. In life, variable depending on color of *Muricella* sp. with which it is living. Types "creamy white with spaced orange-yellow streaks becoming ring-like on the tail, and the bumps over its head (coronet and nuchal plates) and along the body segments imitate the yellow and orange clumps of spicules of the gorgonian" (Whitley, 1970). Others greyish white with scarlet markings (Fig. 6).

Distribution and ecology. So far, only known from New Caledonia where it has been taken solely on the gorgonian *Muricella* sp.

Remarks. Whitley (1970) did not select a holotype from the syntypic series. The larger, AMS I.15418–002 (Fig. 5), is here designated lectotype. The specimen registered as AMS I.19834–001 was apparently collected at the same time as the two types but was not sent to the AMS until after Whitley had published his description (J. Paxton, personal communication).

Although seahorses are known for their cryptic appearance, few, if any, have developed the extreme protective coloration and morphology of *H. bargibanti*. The resemblance of this species to the gorgonian with which it lives is so close that the type series was only noticed after a stalk of gorgonian was collected and placed in an aquarium (J. Paxton, personal communication). Subsequent specimens of *H. bargibanti* have been taken by targeting its more highly visible gorgonian partner.

The five specimens examined are very similar morphologically. Although none has the obvious external pouch development found in other species of the genus, one of the three non-type specimens examined by A. Vincent and J. Pritchard (personal communication) is a male. It differs slightly from the other four in the ossified posterior trunk segments that are directed perpendicularly from the vertebral column (as observed in radiographs) with one of the ventral ossifications expanded basally. This difference is considerably less pronounced than observed in other species of the genus. The inflated appearance of the trunk in most of the specimens of *H. bargibanti* may be related to the reduced ossification of the more anterior segments and thus the greater flexibility of the region.

Discussion

Sufficient evidence appears to exist to recognise *H. bargibanti* and *H. minotaur* as constituting a monophyletic lineage (see *H. minotaur* 'Remarks'). The temptation to propose a new generic name for the two is resisted because little information is available on the overall interrelationships of the species currently referred to *Hippocampus*.

Acknowledgments

The illustration of *H. angustus* was provided by F. Neira (Victorian Fisheries Research Institute). All others were prepared by R. Campbell (NMV). The colour photo of *H. bargibanti* was kindly supplied by J. Rivaton (ORSTOM). I am grateful to A. Steffe (New South Wales Fisheries) for conveying his observations on the distribution of *H. minotaur* and to A. Vincent and J. Pritchard (University of Oxford) for their opinions on the sexes of three of the five specimens of *H. bargibanti*. M. McGrouther (AMS) facilitated the loan of specimens and forwarded information. J. Paxton (AMS) provided useful information on specimens of *H. bargibanti* and commented on the manuscript. L. Jonker (NMV) assisted with radiographs. P. Gunn (NMV) prepared Figure 4. R. Vari (US National Museum of Natural History) made helpful suggestions which improved the manuscript.

References

Burgess, W.E., Axelrod, H.R. and Hunziker, R.E., 1988. *Dr. Burgess's atlas of marine aquarium fishes.* T.F.H. Publications: Neptune City. 736 pp., 563 pls.

Dawson, C.E., 1986a. Syngnathidae. Pp. 445–458 in: Smith, M.M. and Heemstra, P.C. (eds), *Smiths' sea fishes.* MacMillan South Africa: Johannesburg. 1047 pp.

Dawson, C.E., 1986b. Syngnathidae. Pp. 628–639 in: Whitehead, P.J.P., Bauchot, M.-L., Hureau, J.-C., Nielsen, J. and Tortonese, E. (eds), *Fishes of the north-eastern Atlantic and the Mediterranean.* UNESCO: Paris. Volume 2, pp. 511–1008.

Dawson, C.E., 1994. Syngnathidae. Pp. 440–475 in: Gomon, M.F., Glover, C.J.M. and Kuiter, R.H. (eds), *The fishes of Australia's south coast.* State Print South Australia: Adelaide. 992 pp.

Ginsburg, I., 1937. Review of the sea horses (*Hippocampus*) found on the coast of American continents and of Europe. *Proceedings of the United States National Museum* 83: 497–594.

Günther, A., 1870. *Catalogue of the fishes in the British Museum. Volume 8. Catalogue of the Physostomi, containing the families Gymnotidae, Symbranchidae, Muraenidae, Pegasidae, and of the Lophobranchii, Plectognathi, Dipnoi, Ganoidei, Chondropterygii, Cyclostomata, Leptocardii, in the British Museum.* British Museum (Natural History): London. xxv + 549 pp.

Masuda, H., Amaoka, K., Araga, C., Uyeno, T. and Yoshino, T. (Eds), 1984. *The fishes of the Japanese Archipelago.* Tokai University Press: Tokyo. 2 vols. 437 pp., 370 pls.

Vari, R., 1982. The seahorses (subfamily Hippocampinae). Pp. 173–189 in: Böhlke, J.E., Cohen, D.M., Collette, B.B., Eschmeyer, W.N., Gibbs, R.H., Jr., Pietsch, T.W., Richards, W.J., Smith, C.L. and Thomson, K.S. (eds), *Fishes of the western North Atlantic. Part Eight. Order Gasterosteiformes, Suborder Syngnathoidei. Syngnathidae (Doryrhamphinae, Syngnathinae, Hippocampinae). Memoir Sears Foundation for Marine Research* 1(8). 198 pp.

Weber, M. and de Beaufort, L.F., 1922. *The fishes of the Indo-Australian Archipelago. Volume IV. Heteromi, Solenichthyes, Synentognathi, Percesoces, Labyrinthici, Microcyprini.* Brill: Leiden. 410 pp.

Whitley, G.P., 1964. Fishes from the Coral Sea and the Swain Reefs. *Records of the Australian Museum* 26 (5): 145–195, pls VIII-X, figs 1–15.

Whitley, G.P., 1970. *In*: Abstract of proceedings. Ordinary general meeting. 26th November, 1969. *Proceedings of the Linnaean Society of New South Wales* 94 (3): 292–295.

Memoirs of the Museum of Victoria 56(1):255–259 (1997)

A NEW GRENADIER, GENUS *TRACHONURUS*, FROM NEW ZEALAND AND AUSTRALIA (PISCES: GADIFORMES: MACROURIDAE)

TOMIO IWAMOTO[1] AND PETER MCMILLAN[2]

[1]California Academy of Sciences, Golden Gate Park, San Francisco, California 94118, USA
[2]MAF Fisheries, Greta Point, PO Box 297, Wellington, New Zealand

Abstract

Iwamoto, T. and McMillan, P., 1997. A new grenadier, genus *Trachonurus*, from New Zealand and Australia (Pisces: Gadiformes: Macrouridae). *Memoirs of the Museum of Victoria* 56: 255–259.

A new grenadier fish, *Trachonurus gagates*, is described from depths of 436–1240 m off New Zealand and Australia. The species is unusual in lacking a grooved lateral line, which differentiates it from all other known species of the genus. An undescribed species from Australia, however, also lacks a lateral line, but that species has much larger scales and differs in a number of proportional measurements and its paler colour.

Introduction

The generic relationships of *Trachonurus* has recently been considered by Sazonov and Shcherbachev (1985), and its worldwide distribution by Shcherbachev et al. (1979). The latter paper followed Marshall (1973) in treating the five nominal species as synonyms of *T. villosus* (Günther, 1877). Studies by TI, however, revealed that more than one of those five species are probably valid, and several other undescribed species are present. Here, a new species from New Zealand and Australia without a grooved lateral line is described.

Abbreviations and methods for making counts and measurements generally follow Iwamoto (1970) and Iwamoto and Sazonov (1988). Because the new species lacks a grooved lateral line and has only widely spaced free neuromasts, counts of scales above or below the "lateral line" were not possible. Total scale-row counts along a diagonal to the anal fin were useful and are used for this species. Institutional abbreviations follow Leviton et al. (1985) and Leviton and Gibbs (1988).

Trachonurus Günther

Trachonurus Günther, 1887: 142 (as subgenus of *Macrurus*; type species, *Coryphaenoides villosus* Günther, 1877).

See Marshall (1973: 619) and Sazonov and Iwamoto (1992: 77) for descriptions of the genus.

Trachonurus gagates sp. nov.

Figure 1

Trachonurus sp. B: Paulin et al., 1989: 125 (in key).

Material examined. Holotype: AMS I.24059–009 (70.2 HL, 430+ TL); Australia, NSW, off Norah Head; 33°32′S, 15209′E; 978 m; 1983.

Paratypes: Australia, Qld. CSIRO H.1157-01 (73.4 mm HL, 430+ mm TL); WNW of Marion Reef; 1851.1′S, 149°33′E; 599–591 m; FRV *Soela* stn SO6-85-39. CSIRO H.1158-01 (70.0 HL, 412+ TL); NW of Marion Reef; 18°46.0′S, 150°32.1′E; 1188–1200 m; FRV *Soela* stn SO6-85-38; 25 Nov 1985.

NSW. AMS I.24355–001 (53.6 HL, 352+ TL) and CAS 82134 (2: 66.2–72.3 HL, 400+–400+ TL); off Shoalhaven; 3454′S, 151178′E; 1150 m; 1983. AMS I.24173-007 (3: 68.7–74.7 HL, 427+–478+ TL); off Shoalhaven Bight; 34°56′S, 151°13′E; 1115 m; 26 Oct 1983. AMS I.24356-007 (71.7 HL, 425+ TL); 34°51′S, 151°15′E; 1043–1061 m; FRV *Kapala* stn K83-14-05; 26 Jan 1983.

Vic. AMS I.24157-002 (76.0 HL, 450+ TL); off Cape Everard; 38°17′S, 149°47′E; 1015 m; 1983. CSIRO T538 (81.6 HL, 435+ TL); off Cape Martin; 3748′S, 139°33′E; 1007 m; 25 Apr 1983. CSIRO H.2638-01 (49.5 HL, 305+ TL); SE of Portland; 38°53.8′S, 142°00.3′E; FRV *Soela* stn SO2-89-11; 1989.

Tas. CSIRO H.2640-01 (68.7 HL, 410+ TL); FRV *Soela* stn SO2-89-94; 1989. CSIRO H.2634-03 (45.5 HL, 305 TL); SW of Macquarie Harbour; 42°28.6′S, 144°44.0′E; 1000 m; FRV *Soela* stn SO2-89-85; 1989. CSIRO H.886-03 (71.0 HL, 430+ TL); E coast; 41°24.3′S, 14843.7′E; 890–1052 m; FRV *Soela* stn SO4-87-09; 1987. CSIRO T829 (69.3 HL, 400+ TL); off Bicheno; 41°48′S, 148°38′E; 1099 m; *Challenger* stn 40/02; 21 Apr 1982. CSIRO T739 (60.6 HL, 342+ TL); off Cape Sorell; 4224′S, 144°40′E; 1130–1150 m; FV *Margaret Phillipa* stn 03/07; 22 Oct 1983.

SA. NMV A.5880 (2: 54.9–59.4 HL, 334–381 TL); 38°31.67′S, 140°43.91′E; 1100 m. NMV A.5882 (56.8 HL, 350 TL); 38°36.1′S, 140°58.9′E; 1080–1110 m; FRV *Soela* stn SO10-88-83; 8 Feb 1988. NMV A.8995 (75.3 HL, 393+ TL); 33°57.7′S, 131°26.4′E; 1000–1030 m; FV *Comet* stn RP26; 19 Feb 1990.

Figure 1. Holotype of *Trachonurus gagates*, AMS I.24059–009, 70.2 mm HL, 430+ mm TL, from off New South Wales, Australia, in 978 m. Photograph by Susan Middleton.

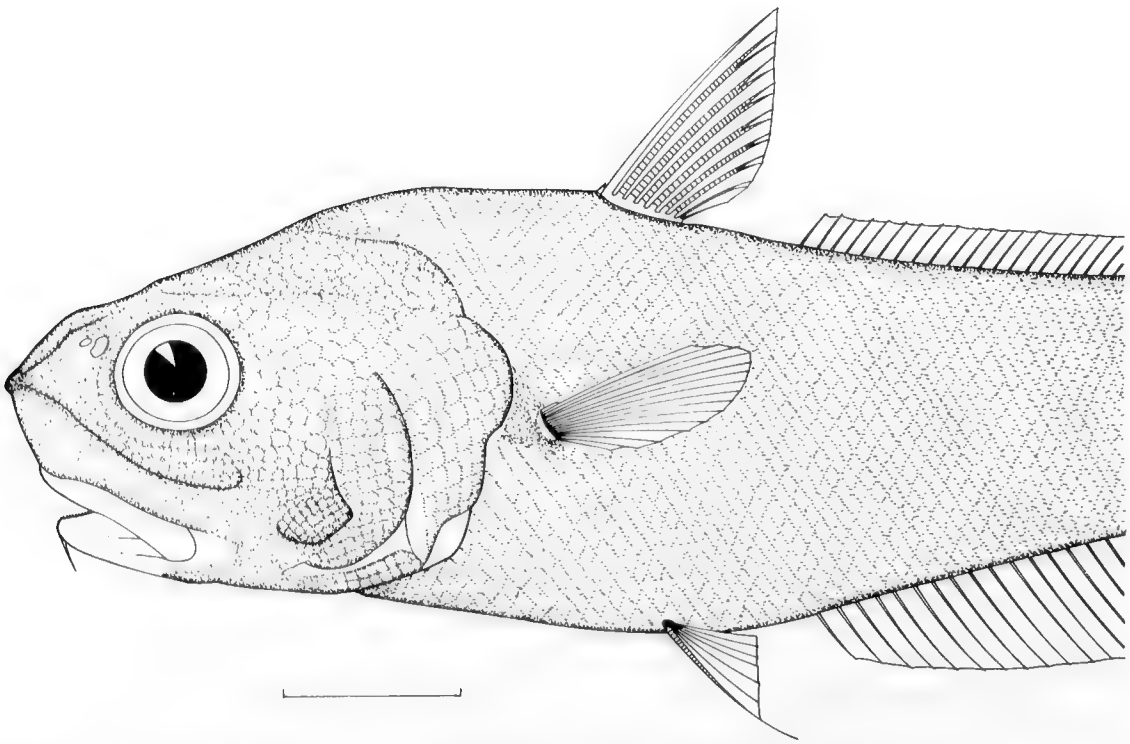


Figure 2. Paratype of *Trachonurus gagates*, NMNZ P.15855, 70.6 mm HL, 435+ mm TL, from west coast of North Island, New Zealand, in 800–848 m. Drawing by Peter McMillan.

CSIRO T316 (61.9 HL, 390+ TL); Great Australian Bight; 34°25′S, 132°05′E; 1175 m; FV *Margaret Phillipa* stn 6/19; 14 Feb 1984. CSIRO T747 (69.7 HL, 370+ TL); 33°49′S, 129°33′E; 1000–1052 m; *Endeavour* stn 04/09; 5 Jun 1983.

WA. CSIRO T289 (59.4 HL, 370+ TL); Great Australian Bight; 33°27′S, 128°36′E; 1027 m; FV *Margaret Phillipa* stn 7/3; 24 Feb 1983. CSIRO H.3022-04 (69.1 HL, 405+ TL); 33°17′S, 114°13′E; 976 m; 1989. CSIRO H.3023-08 (81.8 HL, 465+ TL); W of Bunbury; 33°20′S, 114°30′E; 435 m; 25 Dec 1989. CSIRO H.3002-05 (51.2 HL, 333+ TL); SE of Albany; 35°23′S, 118°27′E; 1030 m; 21 Dec 1989. CSIRO H.2617-07 (64.5 HL, 420+ TL); W of Bunbury; 33°15.8′S, 114°11.1′E; 982 m; FRV *Southern Surveyor* stn SS1-91-85; 1991.

New Zealand. NMNZ P.11303 (72.3 HL, 425+ TL); off Hawke Bay, 39°41.7′S, 177°58.4′E; 1160–1240 m; 24 Nov 1981. NMNZ P.11415 (75.8 HL, 470 TL); W of Cape Reinga; 34°57.4′S, 171°53.2′E; 1060–1080 m; 19 Nov 1981. NMNZ P.11561 (65.7 HL, 392+ TL); off Wairarapa; 41°04.5′S, 176°32.6′E; 960–1100 m; 18 Dec 1981. NMNZ P.12969 (62.0 HL, 355+ TL); NE of Chatham I.; 42°49.9′S, 176°08.2′W; 1050 m; 7 Aug 1982. NMNZ P.14763 (53.0 HL, 327+ TL); Challenger Plateau; 3830.3′S, 17041.9′E; 827–836 m; 25 Oct 1983. NMNZ 14770 (48.8 HL, 300+ TL); Challenger Plateau; 39°31.8′S, 167°47.0′E; 804–817 m; 1 Sep 1983. NMNZ P.15855 (70.6 HL, 435+ TL); west coast, North Island; 37°41.3′S, 173°53.1′E; 801–848 m; 25 Apr 1981. NMNZ P.15856 (73.4 HL, 428+ TL); off Wairarapa; 41°11.0′S, 176°40.0′E; 1070–1180 m; 4 Apr 1984. NMNZ P.15857 (72.4 HL, 432+ TL); north Chatham Rise; 42°37.4′S, 176°19.0′E; 1065–1070 m; 18 Aug 1982. NMNZ P.15858 (70.0 HL, 404+ TL); north Chatham Rise; 42°42.3′S, 175°32.6′E; 1060–1070 m; 29 Aug 1982. NMNZ P.16105 (70.3 HL, 423+ TL); Challenger Plateau; 40°01.9′S, 168°10.9′E; 865–870 m; 14 Jul 1984. NMNZ P.16106 (73.2 HL, 423+ TL); Challenger Plateau; 39°57.5′S, 167°59.5′E; 886–900 m; 11 Jul 1984.

Diagnosis. *Trachonurus* without a grooved lateral line; chin barbel short, 4–8% of head length (HL); suborbital width 13–15%; postorbital length of head 50–55%; gill rakers on first (outer) arch (mesial) 11–13 total, gill rakers on second arch (lateral/mesial) 10–13 total/10–12 total; scale rows below mid-base of first dorsal fin 25–31; scale rows below origin of second dorsal fin 20–25; scale rows over distance equal to predorsal length usually 35–42; scale rows between pelvic fin base and gill cover 11–14.

Measurements and counts. Total lengths 300–478+ mm; head lengths 45.5–81.8 mm. The following in percent of head length (figures in parentheses are exceptions to the usual range): postrostral length 75–80; snout length 24–27; preoral length (height) (12)14–17; internasal width 20–23; interorbital width 31–38 (40); orbit diameter 25–30; suborbital width 13–15; postorbital length 50–54; distance orbit to preopercle angle 36–42; length upper jaw 34–39; length barbel 4–8; length outer gill slit 13–17; preanal length 149–174; distance outer pelvic to anal-fin origin 26–40; distance isthmus to anal-fin origin 86–107; greatest body depth 74–102; 1D-2D interspace 14–35; height 1D. 45–53; length P. 38–54; length V. 30–42; length posterior nostril 4–8.

1D. II,7–9; P. (i9, i11) i12-i16; V. 6–7; total gill-rakers outer arch (lateral/mesial) 3–8 / 11–13, second arch 10–13 / 10–12; scales below 1D. 8–10, below mid-base of 1D. (to A.) (25) 27–31, below 2D. (20) 21–25, over distance equal to predorsal length 35–42; scales from pelvic base to gill cover 11–14; pyloric caeca 10–14.

Description of holotype (with additions from paratypes). Body long and gradually tapering from trunk to end of tail. Head about sixth total length; laterally compressed, completely lacking strong sharp ridges. Snout bluntly rounded in lateral profile, scarcely extending beyond jaws; snout narrow in dorsal view, obtusely conical, broadening notably above nostrils at anterodorsal corner of orbits. Interorbital space broad, mostly flat, dorsal orbital margin forming shallow curved incursion into interorbital space. Suborbital region vertical, flattened, and lacking well-developed horizontal ridge. Mouth moderately large, jaws extending to vertical slightly behind midorbit; lips thick and fleshy. Preopercle broadly rounded, without developed ridge. Opercle and subopercle forming deep, narrow, inverted triangle. Interopercle broadly exposed laterally and posteriorly, densely scaled and connected to similarly densely scaled lower jaw. Chin barbel short, thick at base, tapering rapidly to tip. Abdominal cavity long, extending posteriorly to over 8th–10th anal ray. Gill rakers on outer side of first (outer) arch few small nubs; mesial rakers more tubercular, with forwardly directed tufts of long, recurved spinules.

Fins all small and typical of genus. Second spinous ray of first dorsal fin slender, flexible, tapering to thin tip and wholly lacking serrations on leading edge. Second dorsal scarcely developed anteriorly and consisting of short unconnected rays over most of posterior length. Pectoral fins small, short, tips fine and easily broken (about half head length in better specimens). Pelvic fins small, outer ray with fine tips that barely extend to anal fin origin; origin far posterior, almost vertical to hind edge of first dorsal fin.

Teeth small but relatively stout, in narrow bands in both jaws; about 3 or 4 teeth wide near symphysis in upper jaw, narrowing to 2 rows and then 1 row at extreme posterior end; outer series slightly larger than inner series. Lower jaw in 3 irregular series at symphysis, narrowing rapidly to 2 rows, continuing well posterior to end of rictus; inner series slightly larger than outer series.

Body scales relatively small, covered with fine, slender, conical, erect spinules, some spinules over dorsum with strongly curved tips. Spinules generally arranged in a row along anterior edge of exposed field, those posteriorly in somewhat "V" arrangement. Spinules with shallow buttresses or "roots," some interconnected with adjacent spinules. Gular membrane in holotype with dense, elongated patch of small spiny scales; scales absent over bases of lowermost branchiostegal rays. (In paratypes scale cover on gular and branchiostegal membranes variable, but generally heavily present on both membranes.) Ventral scales along base of anal fin somewhat stouter, larger, and with larger spinules than other scales. Dorsal scales along second dorsal fin scarcely larger than scales more ventrad, but with some slightly enlarged and strongly recurved spinules. Scales of head highly variable in shape and size. Those along posterior margin of orbits somewhat larger and more elongate; series along dorsal edge of preopercle larger and slightly stouter. Scales over opercle and subopercle somewhat larger than others of head. Scales on snout, suborbital, mandible, interorbital, and interopercle small. Scales abruptly absent under gill cover, as typical of genus and characteristic of most genera related to *Cetonurus* (as discussed by Sazonov and Shcherbachev, 1985).

Periproct region broad, extensive, subtending most of distance between pelvic and anal fins (as typical of genus). Pyloric caeca short, thick, and simple; length about equal to least suborbital width or much shorter, length usually two to three times caecum width.

Colour in alcohol overall dark brown to blackish. Fins, lips, lining of mouth and gill chambers black. Gill membranes and barbel dark. Abdominal region not noticeably darker externally than adjacent areas.

Size. To about 48 cm total length.

Distribution. New Zealand and Australia (Qld, NSW, Vic., SA, Tas., WA) in 435–1240 m. In New Zealand waters it is found between 32°24′S and 43°30′S (i.e., in central and northern waters on both coasts) at depths of 801–1240 m. It occurs sympatrically with the rarer *Trachonurus* sp. A of Paulin et al. (1989) in waters north of latitude 40°S.

Etymology. From the Greek, *gagates*, velvety black, with reference to the dark scale covering of the body.

Remarks and comparisons. A second undescribed species from Western Australia also lacks a lateral line, but is readily distinguished from *T. gagates* by its much larger scales, longer chin barbel, narrower internasal and suborbital, wider orbits, shorter postorbital and orbit-to-preopercle distances, and generally paler colour.

Aside from the absence of a lateral line, *T. gagates* appears most similar to *T. villosus* from Australian waters, the two agreeing in almost all counts, proportional measurements, and squamation and dentition features. The exceptions are few and slight with much overlap: the snout length in *T. gagates* is slightly shorter (24–27% HL vs 25–31%), the postorbital length is slightly greater (50–55% HL vs 46–52%), the orbit-to-preopercle distance slightly longer (36–42% HL vs 32–38%), and the chin barbel is shorter (4–8% HL vs 8–14%). Additionally, the number of scale rows along the lateral line over a distance equal to the predorsal length amounts to about 35–42 for most individuals of *T. gagates*, but 39–50 in *T. villosus*.

Acknowledgments

We thank the many curators and assistants who lent specimens and provided other assistance and courtesies during the preparation of this paper: J. Paxton, D. Hoese, M. McGrouther and others (AMS); C. Paulin and A. Stewart (NMNZ); M. Gomon (NMV); P. Last, A. Williams, A. Graham (CSIRO). Susan Middleton (CAS) prepared the excellent photograph of the holotype. Jon Fong and David Catania (CAS) provided technical assistance. An extended visit to Australia by TI was made possible by a visiting fellowship from the Australian Museum. We are grateful to Paxton, Hoese, and J. Leis for assistance with that fellowship, to Last for wrangling funds from the Marine Laboratory, CSIRO (Hobart) to extend TI's visit to that institution, to Gomon for providing housing and hospitality, and to the CAS In-House Research Fund for providing support for visits in 1989 to Australia and New Zealand.

References

Günther, A., 1877. Preliminary notes on new fishes collected in Japan during the expedition of H.M.S. 'Challenger.' *Annals and Magazine of Natural History*, Ser. 4, 20: 433–466.

Günther, A., 1887. Report on the deep-sea fishes collected by H.M.S. Challenger during the years 1873–76. *Report on the Scientific Results of H.M.S. Challenger* (*Zoology*) 22 (part 1) [text]: 1–335; (part 2) [plates]: pls 1–73.

Iwamoto, T., 1970. The R/V Pillsbury Deep-Sea Biological Expedition to the Gulf of Guinea, 1964–65. 19. Macrourid fishes of the Gulf of Guinea. *Studies in Tropical Oceanography* 4 (2): 316–431.

Iwamoto, T. and Sazonov, Y.I., 1988. A review of the southeastern Pacific *Coryphaenoides* (sensu lato) (Pisces, Gadiformes, Macrouridae). *Proceedings of the California Academy of Sciences* 45(3): 35–82, figs 1–9.

Leviton, A.E. and Gibbs, R.H., 1988. Standards in herpetology and ichthyology: standard symbolic codes for institutional resource collections in herpetology and ichthyology. Supplement No. 1: additions and corrections. *Copeia* 1988 (1): 280–282.

Leviton, A.E., Gibbs, R.H., Heal, E. and Dawson C.E., 1985. Standards in herpetology and ichthyology: part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia* 1985 (3): 802–832.

Marshall, N.B., 1973. Family Macrouridae. Pp. 496–665 in: Cohen, D.M. (ed.), Fishes of the western North Atlantic. *Memoirs of the Sears Foundation for Marine Research* 1 (6).

Paulin, C., Stewart, A., Roberts, C. and McMillan, P., 1989. New Zealand fish, a complete guide. *National Museum of New Zealand Miscellaneous Series* 19, 279 pp.

Sazonov, Y.I., and Shcherbachev, Y.N., 1985. Preliminary list of macrourids related to the genus *Cetonurus* Günther (Gadiformes, Macrouridae). II. Genus *Cetonurus* Günther. Comparative taxonomical analysis of recognized groups. [In Russian.] *Voprosy Ikhtiologii* 26(2): 179–195. [English version in *Journal of Ichthyology* 25(3): 12–27.]

Sazonov, Y.I. and Iwamoto, T., 1992. Grenadiers (Pisces, Gadiformes) of the Nazca and Sala y Gomez ridges, southeastern Pacific. *Proceedings of the California Academy of Sciences* 48(2): 27–95, figs 1–37.

Shcherbachev, Y.N., Sazonov, Y.I. and Piotrovskiy, A.S., 1979. Occurrence of *Trachonurus villosus* (Günther) and *Mesobius* (Hubbs et Iwamoto) (Macrouridae, Osteichthyes) in the Indian Ocean. [In Russian.] *Voprosy Ikhtiologii* 19: 20–28, figs 1–2. [English version in *Journal of Ichthyology* 19(1): 16–23].

CONTENTS